

Angles and Angle Measure

Name: _____ Date: _____ Score: _____ / 29

Quick Review

Angles come in two flavors here: **degrees** and **radians**. A full rotation is 360° or 2π radians – same physical sweep, different units. The bridge between them is $180^\circ = \pi$ radians.

Converting. Multiply by whatever conversion factor cancels the unit you've got:

Degrees \rightarrow radians: multiply by $\frac{\pi}{180}$.

Radians \rightarrow degrees: multiply by $\frac{180}{\pi}$.

For example, $60^\circ \cdot \frac{\pi}{180} = \frac{\pi}{3}$, and $\frac{3\pi}{4} \cdot \frac{180}{\pi} = 135^\circ$.

What is a radian really? One radian is the central angle that sweeps out an arc equal in length to the radius. That makes radians a *ratio* of arc length to radius – a pure number, with no units to track. (One radian is about 57.30° .)

Memorize the family. The common conversions show up over and over: $30^\circ = \frac{\pi}{6}$, $45^\circ = \frac{\pi}{4}$, $60^\circ = \frac{\pi}{3}$, $90^\circ = \frac{\pi}{2}$, $180^\circ = \pi$, $270^\circ = \frac{3\pi}{2}$, $360^\circ = 2\pi$. Knowing these by sight saves seconds on every problem.

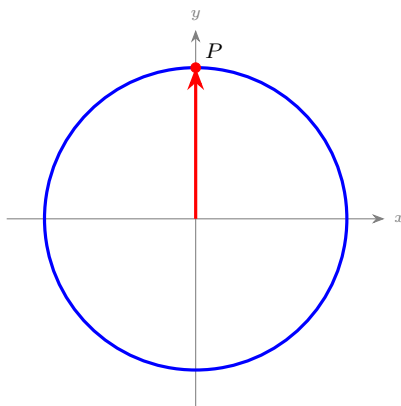
Negative angles work the same way. The sign rides along through the conversion: $-\frac{\pi}{6} \cdot \frac{180}{\pi} = -30^\circ$.

Common slips. Multiplying by $\frac{180}{\pi}$ when you meant $\frac{\pi}{180}$ (the units won't cancel). Forgetting to simplify the fraction at the end – $\frac{315\pi}{180}$ should reduce to $\frac{7\pi}{4}$.

PRACTICE

Convert between degrees and radians. Simplify radian answers to lowest terms.

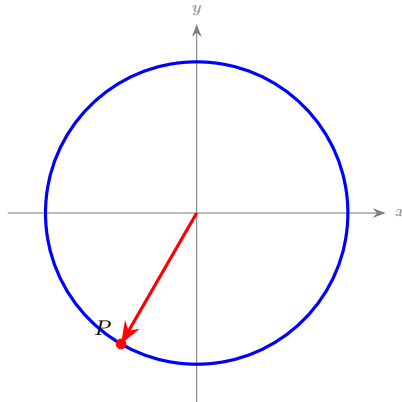
1. Convert the drawn angle (90°) to radians. _____



2. Convert $\frac{\pi}{3}$ radians to degrees. _____
3. Convert 135° to radians. _____
4. Convert $-\frac{\pi}{6}$ to degrees. _____
5. Convert 315° to radians. _____
6. Convert $\frac{5\pi}{6}$ to degrees. _____



7. Convert the drawn angle (240°) to radians. _____



8. Convert $\frac{7\pi}{6}$ to degrees. _____

9. Convert 30° to radians. _____

10. Convert 45° to radians. _____

11. Convert 1 radian to degrees (round to two decimals). _____

12. Convert $-\frac{5\pi}{4}$ to degrees. _____

13. Convert 720° to radians. _____

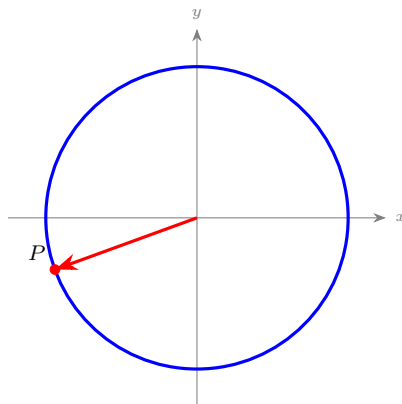
14. Convert $\frac{\pi}{12}$ to degrees. _____

15. Convert 750° to a positive coterminal radian angle in $[0, 2\pi)$. _____

16. Convert -60° to radians. _____

17. Convert $\frac{11\pi}{6}$ to degrees. _____

18. Convert the drawn angle (200°) to radians. _____



19. Convert $\frac{3\pi}{2}$ to degrees. _____

20. Convert 2 radians to degrees (round to two decimals). _____



◆ Word Problems

21. A protractor measures a swing-set arc as 108° . Express this in radians as a simplified fraction of π . _____
22. A bike wheel rotates through $\frac{7\pi}{2}$ radians. How many degrees is that? (Don't reduce coterminally – keep the full rotation count.) _____
23. An ant walks $\frac{\pi}{4}$ radian of arc on a circular track. Convert this to degrees, and decide whether it's less than, equal to, or greater than a 50° arc. _____
24. A clock's minute hand sweeps 25 minutes. In what radian measure (as a simplified fraction of π) did it sweep? Express your answer as a positive angle. _____

Additional Practice

25. Find $\sin \theta$ if opposite = 5, hypotenuse = 13. _____
26. Find $\cos \theta$ if adjacent = 12, hypotenuse = 13. _____
27. Find $\tan \theta$ if opposite = 7, adjacent = 4. _____
28. Find $\sin 30^\circ$. _____
29. Find $\cos 60^\circ$. _____



Answer Keys

1. $\frac{\pi}{2}$	13. 4π
2. 60°	14. 15°
3. $\frac{3\pi}{4}$	15. $\frac{\pi}{6}$
4. -30°	16. $-\frac{\pi}{3}$
5. $\frac{7\pi}{4}$	17. 330°
6. 150°	18. $\frac{10\pi}{9}$
7. $\frac{4\pi}{3}$	19. 270°
8. 210°	20. $\approx 114.59^\circ$
9. $\frac{\pi}{6}$	21. $\frac{3\pi}{5}$
10. $\frac{\pi}{4}$	22. 630°
11. $\approx 57.30^\circ$	23. 45° ; less than 50°
12. -225°	24. $\frac{5\pi}{6}$
Additional Practice Answers	
25. $\frac{5}{13}$	28. $\frac{1}{2}$
26. $\frac{12}{13}$	29. $\frac{1}{2}$
27. $\frac{7}{4}$	

Additional Practice: Answers for all numbered items, including the added practice, are shown in the grid above.

Step-by-Step Explanations

- To go from degrees to radians, multiply by $\frac{\pi}{180}$ so the degree unit cancels:
 $90^\circ \cdot \frac{\pi}{180} = \frac{90\pi}{180} = \frac{\pi}{2}$. A quarter turn is $\frac{\pi}{2}$ – a value worth knowing on sight.
- Keep the rule visible: $\frac{\pi}{3} \cdot \frac{180}{\pi} = \frac{180}{3} = 60^\circ$. The π 's cancel cleanly. This is the part to check before moving on, because it keeps the answer tied to the original question.
- One steady path is: $135^\circ \cdot \frac{\pi}{180} = \frac{135\pi}{180} = \frac{3\pi}{4}$ (divide top and bottom by 45). That gives a quick check on the answer.
- Start with the key idea: The negative sign rides along: $-\frac{\pi}{6} \cdot \frac{180}{\pi} = -30^\circ$. This is the part to check before moving on, because it keeps the answer tied to the original question.
- A careful way to see it: $315^\circ \cdot \frac{\pi}{180} = \frac{315\pi}{180} = \frac{7\pi}{4}$ (divide both by 45). This is the part to check before moving on, because it keeps the answer tied to the original question.
- Keep the rule visible: $\frac{5\pi}{6} \cdot \frac{180}{\pi} = \frac{5 \cdot 180}{6} = 150^\circ$. This is the part to check before moving on, because it keeps the answer tied to the original question.
- Multiply by $\frac{\pi}{180}$: $240^\circ \cdot \frac{\pi}{180} = \frac{240\pi}{180}$. Divide top and bottom by their common factor 60 to land on $\frac{4\pi}{3}$. Always reduce the fraction at the end.
- Start with the key idea: $\frac{7\pi}{6} \cdot \frac{180}{\pi} = \frac{7 \cdot 180}{6} = 7 \cdot 30 = 210^\circ$. This is the part to check before moving on, because it keeps the answer tied to the original question.
- A careful way to see it: $30^\circ \cdot \frac{\pi}{180} = \frac{\pi}{6}$. (Worth memorizing – this one shows up constantly.) That gives a quick check on the answer.
- Keep the rule visible: $45^\circ \cdot \frac{\pi}{180} = \frac{45\pi}{180} = \frac{\pi}{4}$. This is the part to check before moving on, because it keeps the answer tied to the original question.
- One steady path is: $1 \cdot \frac{180}{\pi} = \frac{180}{\pi} \approx 57.30^\circ$. Useful sanity-check number: one radian is a bit less than 60° . That gives a quick check on the answer.

- Start with the key idea: Keep the sign: $-\frac{5\pi}{4} \cdot \frac{180}{\pi} = -\frac{5 \cdot 180}{4} = -225^\circ$. This is the part to check before moving on, because it keeps the answer tied to the original question.
- A careful way to see it: $720^\circ \cdot \frac{\pi}{180} = \frac{720\pi}{180} = 4\pi$. Two full rotations = 4π radians. This is the part to check before moving on, because it keeps the answer tied to the original question.
- Keep the rule visible: $\frac{\pi}{12} \cdot \frac{180}{\pi} = \frac{180}{12} = 15^\circ$. This is the part to check before moving on, because it keeps the answer tied to the original question.
- First convert: $750^\circ \cdot \frac{\pi}{180} = \frac{25\pi}{6}$. Now subtract full rotations of $2\pi = \frac{12\pi}{6}$:
 $\frac{25\pi}{6} - \frac{24\pi}{6} = \frac{\pi}{6}$.
- Start with the key idea: $-60^\circ \cdot \frac{\pi}{180} = -\frac{60\pi}{180} = -\frac{\pi}{3}$. This is the part to check before moving on, because it keeps the answer tied to the original question.
- A careful way to see it: $\frac{11\pi}{6} \cdot \frac{180}{\pi} = \frac{11 \cdot 180}{6} = 11 \cdot 30 = 330^\circ$. This is the part to check before moving on, because it keeps the answer tied to the original question.
- Multiply by $\frac{\pi}{180}$: $200^\circ \cdot \frac{\pi}{180} = \frac{200\pi}{180}$. The greatest common factor of 200 and 180 is 20, so divide both by 20 to get $\frac{10\pi}{9}$ (it does not reduce to a π/n form – that's fine).
- One steady path is: $\frac{3\pi}{2} \cdot \frac{180}{\pi} = \frac{3 \cdot 180}{2} = 270^\circ$. This is the part to check before moving on, because it keeps the answer tied to the original question.
- The input is unitless, so use the radians-to-degrees factor: $2 \cdot \frac{180}{\pi} = \frac{360}{\pi} \approx 114.59^\circ$. (Quick sanity check: one radian is about 57.3° , so two radians is about $2 \cdot 57.3 = 114.6^\circ$ – just under 120° , which matches.)
- A careful way to see it: $108^\circ \cdot \frac{\pi}{180} = \frac{108\pi}{180} = \frac{3\pi}{5}$ (divide both by 36). The arc covers $3/5$ of a half-circle. That gives a quick check on the answer.
- Keep the rule visible: $\frac{7\pi}{2} \cdot \frac{180}{\pi} = \frac{7 \cdot 180}{2} = 630^\circ$. The wheel made one full



turn (360°) plus another 270° – so it's now pointing where 270° would, after one extra revolution. That gives a quick check on the answer.

23. One steady path is: $\frac{\pi}{4} \cdot \frac{180}{\pi} = 45^\circ$. That's 5° less than 50° , so the ant's arc is smaller. (Sanity check: 45° is half of a right angle.) That gives a quick check on

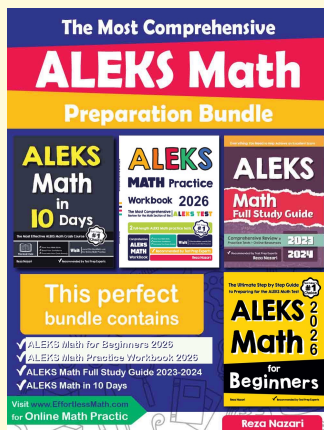
the answer.

24. A full hour is 360° over 60 minutes, so each minute is 6° . Twenty-five minutes is $25 \cdot 6 = 150^\circ$. Convert: $150^\circ \cdot \frac{\pi}{180} = \frac{150\pi}{180} = \frac{5\pi}{6}$. (Reality check: 25 min is just under half an hour, and $\frac{5\pi}{6}$ is just under π – matches.)



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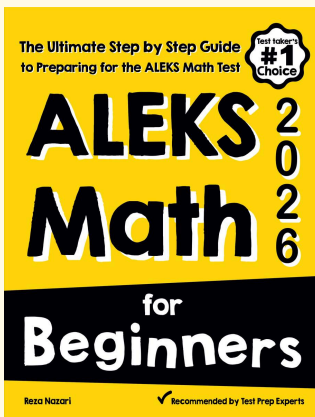
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