MATHEMATICS · GRADES 10-12

Degrees versus radians

Difficulty level: Advanced

Mathematics: Grades 10-12

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Overview of the concept

These are two ways to measure an angle, like measuring a distance in kilometres or miles. Degrees are the ones you meet in everyday life, on a protractor or a map, while radians are the ones maths and science use in formulas. Knowing which one your calculator expects keeps your answer right, since the same angle gives a different number in each unit. It is a small detail that makes a big difference when the answer has to be exact.



Rule

180 degrees equals pi radians.

Degrees and radians are two ways to measure the same angle, and a half turn is 180 degrees or pi radians. To convert, multiply by $\frac{\pi}{180}$ to get radians, or by $\frac{180}{\pi}$ to get degrees.

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Worked examples

EXAMPLE 1

Q Convert 150° to radians. Give your answer in terms of π.

SOLUTION

This is a degrees to radians conversion, so the one rule to remember is: multiply by π over 180.

$150° \times \frac{\pi}{180} = \frac{150\pi}{180}$

150 and 180 share a factor of 30, so $\frac{150\pi}{180} = \frac{5\pi}{6}$ radians

EXAMPLE 2

Q Convert $\frac{7\pi}{6}$ radians to degrees.

SOLUTION

This is a radians to degrees conversion, so multiply by 180 over π, the other way round.

$\frac{7\pi}{6} \times \frac{180}{\pi} = 7 \times 30$, because the π cancels and $180 \div 6 = 30$

That gives 210°.

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Practice questions

1 Convert 120° to radians. Give your answer in terms of π.

- **A** $\frac{2\pi}{3}$
- **B** $\frac{\pi}{3}$
- **C** $\frac{4\pi}{3}$
- **D** $\frac{3\pi}{4}$

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2 Which is larger: 90° or 2 radians?

- **A** 2 radians
- **B** 90°
- **C** They are equal
- **D** You cannot compare degrees and radians

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3 Convert $\frac{3\pi}{4}$ radians to degrees.

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4 Convert 1.5 radians to degrees. Give your answer to the nearest degree.

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5 Convert 2.5 radians to degrees. Give your answer to the nearest degree.

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6 Convert 200° to radians. Give your answer to two decimal places.

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7 Convert −60° to radians. Give your answer in terms of π.

A $\frac{\pi}{3}$

B $-\frac{\pi}{3}$

C $-\frac{2\pi}{3}$

D $-\frac{\pi}{6}$

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8 Convert $-\frac{5\pi}{4}$ radians to degrees.

A −135°

B 225°

C −225°

D −315°

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9 **Put these in order from smallest to largest:**

1. $120°$
2. 2 radians
3. $\frac{3\pi}{4}$ radians

A) 120°, 2 radians, $\frac{3\pi}{4}$ radians

B) 2 radians, 120°, $\frac{3\pi}{4}$ radians

C) 2 radians, $\frac{3\pi}{4}$ radians, 120°

D) $\frac{3\pi}{4}$ radians, 120°, 2 radians

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10 A wheel of radius 0.5 m turns through $\frac{2\pi}{3}$ radians. How far does a point on the rim travel? Give your answer in terms of π.

A $\frac{\pi}{3}$ m

B $\frac{2\pi}{3}$ m

C $\frac{\pi}{6}$ m

D π m

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ANSWER KEY

1. $\frac{2\pi}{3}$

2. 2 radians

3. 135°

4. 86°

5. 143°

6. 3.49 radians

7. $-\frac{\pi}{3}$

8. –225°

9. 2 radians, 120°, $\frac{3\pi}{4}$ radians

10. $\frac{\pi}{3}$ m

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