Rational and Irrational Numbers

Name: ______	Date: ______	Score: ____ / 24

Quick Review

A **rational number** is any number you can write as a fraction $\frac{a}{b}$ of two integers (with $b \neq 0$). When you write a rational number as a decimal, it always either *stops* (like 0.75) or *repeats* a pattern forever (like $0.3333\ldots$). An **irrational number** cannot be written as such a fraction — its decimal goes on forever with *no repeating pattern*. Famous examples are π and most square roots, such as $\sqrt{2}$ and $\sqrt{10}$. A quick test: $\sqrt{n}$ is rational only when n is a **perfect square** (like $\sqrt{49} = 7$); otherwise it is irrational.

◇ **Example:** Tell whether $\sqrt{45}$ is rational or irrational.
⇒ Start by asking the key question: is 45 a perfect square? The perfect squares near it are $36 = 6^2$ and $49 = 7^2$, and 45 is stuck *between* them — it is not a perfect square. That means $\sqrt{45}$ is not a whole number, and in fact its decimal $6.7082\ldots$ never stops and never repeats. So $\sqrt{45}$ cannot be written as a fraction of integers — it is **irrational**.

Answer: $\sqrt{45}$ is irrational

PRACTICE

Classify each number as rational or irrational.

1. $\frac{3}{5}$ ______
2. $\sqrt{49}$ ______
3. $\sqrt{7}$ ______
4. 0.25 ______
5. π ______
6. -8 ______
7. $0.\overline{6}$ ______
8. $\sqrt{16}$ ______
9. $\sqrt{20}$ ______
10. $\frac{0}{9}$ ______
11. $2.\overline{18}$ ______
12. $\sqrt{100}$ ______
13. $-\sqrt{2}$ ______
14. 3.5 ______
15. $\sqrt{64}$ ______
16. $\sqrt{2}+1$ ______
17. $\frac{22}{7}$ ______
18. $0.1010010001\ldots$ ______
19. $\sqrt{81}$ ______
20. $\sqrt{50}$ ______

♦ Word Problems

21. A square garden has an area of 36 square feet. Is the side length a rational or an irrational number? Explain. ______
22. A different square tile has an area of 30 square inches. Is its side length rational or irrational? ______
23. Maria says every number that has a decimal point is irrational. Give one example that shows she is wrong. ______
24. A circle has a radius of 4 cm. Its circumference is $2\pi r = 8\pi$ cm. Is the exact circumference rational or irrational? ______

Answer Keys

1.	rational	13.	irrational
2.	rational	14.	rational
3.	irrational	15.	rational
4.	rational	16.	irrational
5.	irrational	17.	rational
6.	rational	18.	irrational
7.	rational	19.	rational
8.	rational	20.	irrational
9.	irrational	21.	rational; side $= 6$ ft
10.	rational	22.	irrational; side $= \sqrt{30}$ in
11.	rational	23.	$0.5 = \frac{1}{2}$ (rational)
12.	rational	24.	irrational

Step-by-Step Explanations

1. It is already a fraction of two integers, so it is rational by definition.
2. $49 = 7^2$ is a perfect square, so $\sqrt{49} = 7$, a whole number — rational.
3. 7 is between the perfect squares 4 and 9, so $\sqrt{7}$ is not a whole number and does not repeat — irrational.
4. This decimal stops, and $0.25 = \frac{1}{4}$, so it is rational.
5. $\pi = 3.14159\ldots$ goes on forever with no repeating pattern, so it is irrational.
6. Every integer is rational: $-8 = \frac{-8}{1}$.
7. A repeating decimal is rational; in fact $0.\overline{6} = \frac{2}{3}$.
8. $16 = 4^2$ is a perfect square, so $\sqrt{16} = 4$ — rational.
9. 20 sits between 16 and 25, so it is not a perfect square and $\sqrt{20}$ is irrational.
10. $\frac{0}{9} = 0$, and 0 is an integer, so it is rational.
11. The block 18 repeats forever, and any repeating decimal can be written as a fraction — rational.
12. $100 = 10^2$, so $\sqrt{100} = 10$, a whole number — rational.
13. $\sqrt{2}$ is irrational, and negating an irrational number keeps it irrational.
14. This decimal stops: $3.5 = \frac{7}{2}$, so it is rational.
15. $64 = 8^2$, so $\sqrt{64} = 8$ — a perfect square root is rational.
16. Adding the rational number 1 to the irrational $\sqrt{2}$ still gives an irrational number.
17. It is a ratio of two integers — rational. (It is a famous *approximation* of π, but not equal to π.)
18. The decimal grows forever but the digits never settle into a repeating block, so it is irrational.
19. $81 = 9^2$, so $\sqrt{81} = 9$ — rational.
20. 50 lies between 49 and 64, so it is not a perfect square and $\sqrt{50}$ is irrational.
21. The side length is $\sqrt{36}$, and $36 = 6^2$ is a perfect square, so $\sqrt{36} = 6$ ft — a whole number, which is rational.
22. The side is $\sqrt{30}$. Since 30 is between the perfect squares 25 and 36, it is not a perfect square, so $\sqrt{30}$ is irrational.
23. A decimal that stops or repeats is rational. For example 0.5 has a decimal point but equals $\frac{1}{2}$, so Maria's rule is false.
24. The circumference is 8π. Since π is irrational, multiplying it by the nonzero rational number 8 keeps the result irrational.

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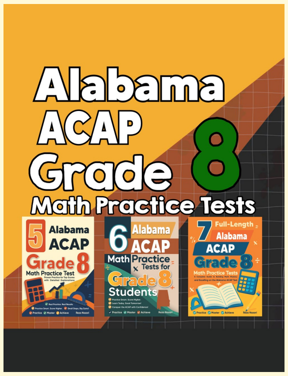

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