Square Root of a Whole Number

To simplify a radical containing a radicand that is not a perfect square, reverse the Product Rule for Square Roots. Rewrite the radicand as the product of factors where as many factors as possible are perfect squares. Write each factor as a separate radical and evaluate each. Multiply the results.

$$\sqrt{a \cdot b} = \sqrt{a} \cdot \sqrt{b} \qquad \sqrt{32} = \sqrt{16 \cdot 2} = \sqrt{16} \cdot \sqrt{2} = 4\sqrt{2}$$

$$\sqrt{500} = \sqrt{100 \cdot 5} = \sqrt{100} \cdot \sqrt{5} = 10\sqrt{5}$$

This process helps when one doesn't recognize larger perfect squares. Factor the radicand completely. (Use a factor tree if necessary.) Group two similar factors together to form perfect squares.

Example: (The thinking process for factoring 1764.)

$\sqrt{1764}$

1764 = 2 · 882	(1764 - even – must be divisible by 2.)
1764 = 2 · 2 · 441	(882 – even – must be divisible by 2.)
1764 = 2 · 2 · 3 · 147	(441 – digits add up to a multiple of 3, so divisible by 3.)
1764 = 2 · 2 · 3 · 3 · 49	(147 – digits add up to a multiple of 3, divisible by 3.)
1764 = 2 · 2 · 3 · 3 · 49	(recognize 49 as a perfect square, combine like factors)
1764 = 4 · 9 · 49	

$$\sqrt{1764} = \sqrt{4} \cdot \sqrt{9} \cdot \sqrt{49} = 2 \cdot 3 \cdot 7 = 42$$

If the original had been $\sqrt{3528}$, the number 3528 would have factored into 2 · 2 · 2 · 3 · 3 · 49.
The result would have been: $\sqrt{3528} = \sqrt{2} \cdot \sqrt{4} \cdot \sqrt{9} \cdot \sqrt{49} = \sqrt{2} \cdot 2 \cdot 3 \cdot 7 = 42\sqrt{2}$

TRY:

$\sqrt{45}$ $\qquad$ $\sqrt{72}$

$\sqrt{98}$ $\qquad$ $\sqrt{125}$