You’ll need a calculator for this one.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ApproximatingNonperfect Square Roots | Approximate $\sqrt{2}.$

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Number | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Number Squared | 0 | **1** | **4** | 9 | 16 | 25 | 36 | 49 | 64 | 81 | 100 |

$\sqrt{2}$ should fall in between 1 $(=\sqrt{1})$ and 2 $\left(=\sqrt{4}\right).$Let’s try to find a more precise estimate than just between 1 and 2.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Number | 1.0 | 1.1 | 1.2 | 1.3 | 1.4 | 1.5 | 1.6 | 1.7 | 1.8 | 1.9 | 2.0 |
| Number Squared | 1 | 1.21 | 1.44 | 1.69 | **1.96** | **2.25** | 2.56 | 2.89 | 3.24 | 3.61 | 4 |

Looking at this table, we can see that a closer estimate would be between 1.4 and 1.5. We can be even more precise.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Number | 1.40 | 1.41 | 1.42 | 1.43 | 1.44 | 1.45 | 1.46 | 1.47 | 1.48 | 1.49 | 1.50 |
| Number Squared | 1.96 | **1.9881** | **2.0164** |  |  |  |  |  |  |  |  |

An even closer estimate would be between 1.41 and 1.42. Since 1.9881 is closer to 2 than 2.0164, the better approximation is **1.41**. So, $\sqrt{2}≈1.41.$ |
| Approximate $\sqrt{33}.$

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Number | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Number Squared | 0 | 1 | 4 | 9 | 16 | **25** | **36** | 49 | 64 | 81 | 100 |

$\sqrt{33}$ is in between 5 and 6. Let’s zoom in further.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Number | 5.0 | 5.1 | 5.2 | 5.3 | 5.4 | 5.5 | 5.6 | 5.7 | 5.8 | 5.9 | 6.0 |
| Number Squared | 25 | 26.01 | 27.04 | 28.09 | 29.16 | 30.25 | 31.36 | **32.49** | **33.64** | 34.81 | 36 |

$\sqrt{33}$ is in between 5.7 and 5.8. Let’s zoom in even further.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Number | 5.70 | 5.71 | 5.72 | 5.73 | 5.74 | 5.75 | 5.76 | 5.77 | 5.78 | 5.79 | 5.80 |
| Number Squared | 32.49 | 32.6041 | 32.7184 | 32.8329 | **32.9476** | **33.0625** |  |  |  |  |  |

An even closer estimate would be between 5.74 and 5.75. Since 32.9476 is closer to 33 than 33.0625, the better approximation is 5.74. So, $\sqrt{33}≈5.74.$ |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Approximate $\sqrt{20}.$

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Number | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Number Squared | 0 | 1 | 4 | 9 | **16** | **25** | 36 | 49 | 64 | 81 | 100 |

$\sqrt{20}$ is in between 4 and 5.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Number | 4.0 | 4.1 | 4.2 | 4.3 | 4.4 | 4.5 | 4.6 | 4.7 | 4.8 | 4.9 | 5.0 |
| Number Squared | 16 | 16.81 | 17.64 | 18.49 | **19.36** | **20.25** |  |  |  |  | 25 |

$\sqrt{20}$ is in between 4.4 and 4.5.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Number | 4.40 | 4.41 | 4.42 | 4.43 | 4.44 | 4.45 | 4.46 | 4.47 | 4.48 |
| Number Squared | 19.36 | 19.4481 | 19.5364 | 19.6249 | 19.7136 | 19.8025 | 19.8916 | **19.9809** | **20.0704** |

An even closer estimate would be between 4.47 and 4.48. Since 19.9809 is closer to 20 than 20.0704, the better approximation is 4.47. So, $\sqrt{20}≈4.47.$ |
| Approximating Pi |  Pi (or π) is approximately 3.14. Memorize this fact! |

Part 2: Estimate each of the following to the **nearest whole number.**

|  |  |
| --- | --- |
| Practice | Estimate 3π.Remember: π $≈$3.14, which rounds to 3. 3(3) = 9, so **3π** $≈$ **9.** |
| Estimate $11-\sqrt{22}$.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Number | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Number Squared | 0 | 1 | 4 | 9 | **16** | **25** | 36 | 49 | 64 | 81 | 100 |

$\sqrt{22}$ is between 4 and 5, but closer to 5. 11- 5 = 6, so $11-\sqrt{22}≈6.$ |
| Estimate $\frac{48}{π}$.Remember: π $≈$3.14, which rounds to 3. $\frac{48}{3}=16$, so $\frac{48}{π}≈16.$ |
|  | Estimate $15\sqrt{15}$.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Number | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Number Squared | 0 | 1 | 4 | **9** | **16** | 25 | 36 | 49 | 64 | 81 | 100 |

$\sqrt{15}$ is between 3 and 3, but closer to 4. 15(4) = 60, so $15\sqrt{15}≈60.$ |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Comparing Irrational Numbers | Use what you’ve learned to place the following numbers into the boxes on the number line.

|  |  |  |  |
| --- | --- | --- | --- |
| 5.8 | 3π | $$\frac{9}{2}$$ | $$\sqrt{27}$$ |
|  |  |  |  |

65 |
|

|  |  |  |  |
| --- | --- | --- | --- |
| $$\frac{24}{π}$$ | $$\sqrt{79}$$ | $$8.2$$ | $$\sqrt{66}$$ |
| 7 | 8 |  | 9 |

 |