**PRACTICE** | Solve each problem below by estimating.

**42.** Circle the number below that is equal to $37\times27$ without computing the exact answer.

555          999          6,789          9,999

**43.** To estimate the product of $89\times203$, Grogg rounds both numbers to the nearest hundred, then multiplies. Alex rounds both numbers to the nearest ten before multiplying. How much larger is Grogg's estimate than Alex's?

**43.** _____

**44.** Circle the number below that is equal to $231\times533$ without computing the exact answer.

1,234          12,321          123,123          1,234,567

**45.** The quotient $24\frac{1}{3}\div7\frac{8}{9}$ is close to what whole number?

**45.** _____

**46.** Adam estimates $6\times704\approx10\times704=7,040$.
Jon estimates $6\times704\approx6\times700=4,200$.
Can you tell which estimate is closer without computing $6\times704$?
Explain.

**47.** Globb estimates the product $49\times499\times4,999$ by rounding all three numbers to the nearest hundred, then multiplying. What estimate does he get? Is this a ***good*** estimate? If so, explain why.
If not, how should Globb have rounded instead?

# ESTIMATION
## Computing Estimates

An answer is **reasonable** if it makes sense.

By using estimation to check whether our answers are reasonable, we can often catch mistakes and correct them.

**EXAMPLE** | Which of the four computations below is **not** reasonable?

$$681+225 = 906 \qquad 44\times73 = 3{,}212$$

$$75\times18 = 1{,}350 \qquad 897+6{,}041 = 15{,}011$$

We can estimate the value of each sum or product, then compare our estimates to the values above.

$681+225 \approx 700+200 = 900$, which is very close to 906.
$44\times73 \approx 40\times70 = 2{,}800$, which is pretty close to 3,212.
$75\times18 \approx 80\times20 = 1{,}600$, which is pretty close to 1,350.
$897+6{,}041 \approx 900+6{,}000 = 6{,}900$, which is less than half of 15,011.

Our estimate suggests that **897+6,041 = 15,011** is not reasonable. A mistake must have been made in the computation.

In fact, $897+6{,}041 = 6{,}938$.

**PRACTICE** | Place a ✓ in the box next to every computation that is reasonable. Place a ✗ next to every computation that is not reasonable. For each, write an estimate that shows why you chose to write a ✓ or ✗.

48. ☐ $79\times107 = 8{,}453$

49. ☐ $1{,}297+680 = 8{,}097$

50. ☐ $67\times1{,}008 = 7{,}236$

51. ☐ $532+118 = 650$

52. ☐ $89+778 = 1{,}668$

53. ☐ $603\times90 = 54{,}270$

54. ☐ $7\times986 = 69{,}020$

55. ☐ $78\times215 = 1{,}677$

56. ☐ $977+14{,}040 = 15{,}017$

57. ☐ $9\times11\times8 = 792$

58. ☐ $866+1{,}671 = 2{,}567$

59. ☐ $7\times(89+23) = 7{,}784$

In a Short Circuit puzzle, each dot is labeled with an expression. The goal is to draw wires that connect each labeled dot on the left to a dot labeled with an equal expression on the right. The wires must not leave the room, cross each other, or pass through walls.

**EXAMPLE** | Complete the Short Circuit puzzle below by connecting the three pairs of equal expressions.
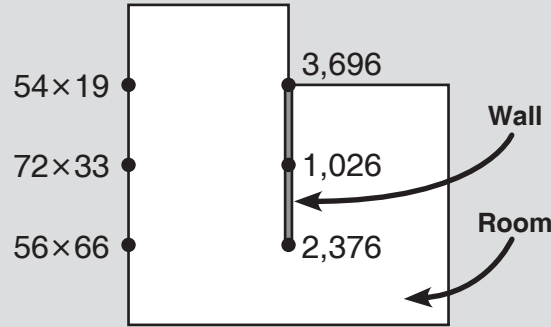


Since the numbers on the right side of the puzzle are not close in value, we do not need to know the exact values of the products on the left to match them to the numbers on the right. So, we begin by estimating the value of each product on the left.

$54 \times 19$ is approximately $50 \times 20 = 1{,}000$. So, we guess that $54 \times 19 = 1{,}026$.
$72 \times 33$ is approximately $70 \times 30 = 2{,}100$. So, we guess that $72 \times 33 = 2{,}376$.
$56 \times 66$ is approximately $60 \times 70 = 4{,}200$. So, we guess that $56 \times 66 = 3{,}696$.

We must connect $54 \times 19$ to the dot labeled 1,026,
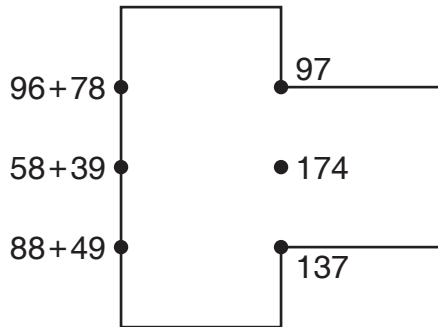$72 \times 33$ to the dot labeled 2,376, and $56 \times 66$ to 3,696.
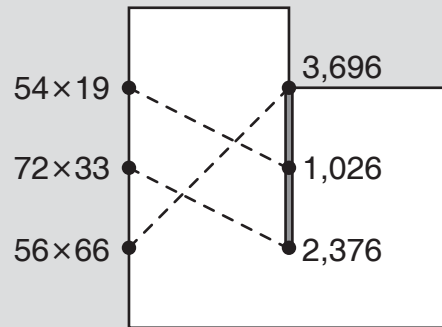


To avoid crossing wires, we can connect $56 \times 66$ to 3,696 by going around the wall in the middle of the room as shown below. We connect the other pairs with straight lines.
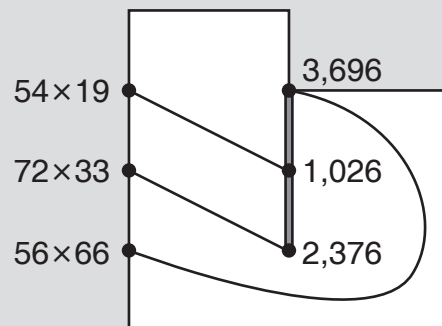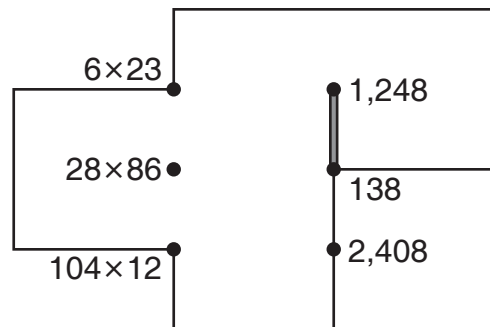
**PRACTICE** | Complete each Short Circuit puzzle below.
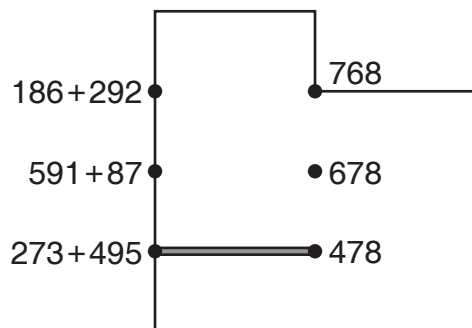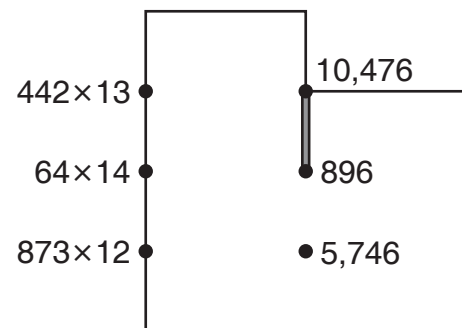We recommend you use a pencil.

**60.**

96+78 •          • 97

58+39 •          • 174

88+49 •          • 137

**61.**

6×23 •          • 1,248

28×86 •          138

104×12 •          • 2,408

**62.**

186+292 •          • 768

591+87 •          • 678

273+495 •          • 478

**63.**

442×13 •          • 10,476

64×14 •          • 896

873×12 •          • 5,746

**64.**

$3\frac{3}{5}+1\frac{1}{2}$ •          • $13\frac{1}{2}$

$5\frac{2}{3}+7\frac{5}{6}$ •          $8\frac{7}{8}$

$6\frac{3}{4}+2\frac{1}{8}$ •          • $5\frac{1}{10}$

**65.**

$3\frac{3}{5}\times1\frac{2}{3}$ •          • 21

$1\frac{7}{9}\times5\frac{5}{8}$ •          10

$8\frac{3}{4}\times2\frac{2}{5}$ •          • 6