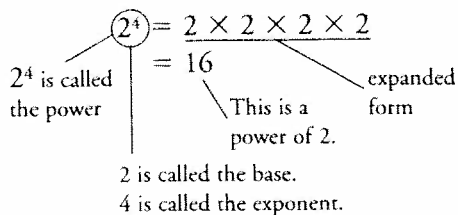


## Number Sense and Numeracy: Factors and Exponents

### Example 1



### Example 2

Calculate  $2^3 \times 2^2$ .

#### Solution

$$2^3 \times 2^2 = 2 \times 2 \times 2 \times 2 \times 2$$

like bases

$$= 32$$

### Example 3

Evaluate  $2^2 \times 3^2$ .

#### Solution

$$2^2 \times 3^2 = 2 \times 2 \times 3 \times 3$$

unlike bases

$$= 36$$

### Practise

1. Write the value of each.

- |           |           |           |
|-----------|-----------|-----------|
| (a) $2^2$ | (b) $2^3$ | (c) $2^4$ |
| (d) $3^2$ | (e) $3^3$ | (f) $3^4$ |
| (g) $4^2$ | (h) $4^3$ | (i) $5^3$ |

2. Simplify.

- |                      |                      |
|----------------------|----------------------|
| (a) $3 \times 2^2$   | (b) $3 \times 2^3$   |
| (c) $2 \times 4^2$   | (d) $2 \times 4^3$   |
| (e) $2^2 \times 3^2$ | (f) $2^2 \times 3^3$ |
| (g) $3^2 \times 2^3$ | (h) $2^2 \times 4^2$ |
| (i) $2^3 \times 4^2$ | (j) $5^2 \times 3^2$ |

3. For each power, what is the base? the exponent?

- |           |           |           |
|-----------|-----------|-----------|
| (a) $2^3$ | (b) $3^2$ | (c) $2^4$ |
| (d) $3^4$ | (e) $5^2$ |           |

4. Write each expression as a power.

- (a)  $3 \times 3 \times 3 \times 3 \times 3$   
 (b)  $2 \times 2 \times 2 \times 2$   
 (c)  $5 \times 5 \times 5$   
 (d)  $4 \times 4 \times 4 \times 4 \times 4 \times 4$

5. Write in expanded form.

- |              |           |              |
|--------------|-----------|--------------|
| (a) $5^2$    | (b) $2^5$ | (c) $6^4$    |
| (d) $x^3$    | (e) $y^4$ | (f) $(2m)^3$ |
| (g) $(3n)^2$ | (h) $4^3$ | (i) $3^4$    |

6. Evaluate:

- (a) the third power of 2  
 (b) the fourth power of 3  
 (c) the second power of 5  
 (d) the fifth power of 1  
 (e) the sixth power of 0  
 (f) the second power of 16

7. Write each number as a power of 10.

- |             |                |
|-------------|----------------|
| (a) 100     | (b) 1000       |
| (c) 100 000 | (d) 1 000 000  |
| (e) 10      | (f) 10 000 000 |

8. Write as a power of 2.

- |        |         |
|--------|---------|
| (a) 4  | (b) 16  |
| (c) 64 | (d) 256 |

9. Evaluate.

- |                    |                      |
|--------------------|----------------------|
| (a) $7^2 + 2^2$    | (b) $4^3 - 2^5$      |
| (c) $3 \times 2^3$ | (d) $3^2 \times 2^2$ |

10. Evaluate for  $x = 2$ .

- |            |                |                 |
|------------|----------------|-----------------|
| (a) $2x$   | (b) $x^2$      | (c) $x^3$       |
| (d) $3x^2$ | (e) $2x^2 + 3$ | (f) $x^3 - x^2$ |

11. Express each number as a product of two powers. (For instance,  $36 = 2^2 \times 3^2$ .)

- |          |        |         |
|----------|--------|---------|
| (a) 100  | (b) 12 | (c) 108 |
| (d) 2500 | (e) 18 | (f) 72  |

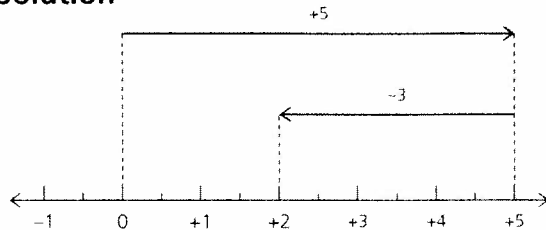
## Number Sense and Numeracy: Integers—Addition and Subtraction

A number line can be used to show how to add integers.

### Example 1

Find  $(+5) + (-3)$ .

#### Solution



$(+5) + (-3) = 2$  — The positive sign is often not used.

To subtract an integer you add its opposite.

### Example 2

Subtract: (a)  $5 - (-2)$  (b)  $-8 - (+3)$

#### Solution

$$\begin{aligned} \text{(a)} \quad 5 - (-2) &= 5 + (+2) \\ &= 7 \end{aligned}$$

$$\begin{aligned} \text{(b)} \quad -8 - (+3) &= -8 + (-3) \\ &= -11 \end{aligned}$$

To subtract an integer, you add its opposite.

### Practise

1. Find each sum.

- |                 |                 |
|-----------------|-----------------|
| (a) $-3 + (-2)$ | (b) $2 + (-3)$  |
| (c) $-8 + (+8)$ | (d) $-6 + (+4)$ |
| (e) $-4 + (-5)$ | (f) $2 + (-6)$  |

2. Add.

- |   |   |   |
|---|---|---|
| (a) $\begin{array}{r} 5 \\ -7 \\ \hline \end{array}$  | (b) $\begin{array}{r} -3 \\ -4 \\ \hline \end{array}$ | (c) $\begin{array}{r} -9 \\ -2 \\ \hline \end{array}$ |
| (d) $\begin{array}{r} -4 \\ -6 \\ \hline \end{array}$ | (e) $\begin{array}{r} 7 \\ -7 \\ \hline \end{array}$  | (f) $\begin{array}{r} 7 \\ -2 \\ \hline \end{array}$  |
| (g) $\begin{array}{r} -8 \\ -4 \\ \hline \end{array}$ | (h) $\begin{array}{r} -4 \\ -3 \\ \hline \end{array}$ | (i) $\begin{array}{r} -5 \\ -5 \\ \hline \end{array}$ |

3. Find each difference.

- |                 |                 |
|-----------------|-----------------|
| (a) $4 - (-3)$  | (b) $-5 - (-2)$ |
| (c) $5 - (-3)$  | (d) $-4 - (-7)$ |
| (e) $6 - (-6)$  | (f) $4 - (4)$   |
| (g) $-7 - (-3)$ | (h) $-7 - (-9)$ |

4. Subtract.

- |   |   |   |
|---|---|---|
| (a) $\begin{array}{r} -4 \\ -2 \\ \hline \end{array}$ | (b) $\begin{array}{r} 5 \\ -3 \\ \hline \end{array}$  | (c) $\begin{array}{r} -7 \\ -3 \\ \hline \end{array}$ |
| (d) $\begin{array}{r} -5 \\ -5 \\ \hline \end{array}$ | (e) $\begin{array}{r} -7 \\ -8 \\ \hline \end{array}$ | (f) $\begin{array}{r} 7 \\ -3 \\ \hline \end{array}$  |

- |   |   |
|---|---|
| (g) $\begin{array}{r} -7 \\ -3 \\ \hline \end{array}$ | (h) $\begin{array}{r} -7 \\ -3 \\ \hline \end{array}$ |
|---|---|

5. Simplify.

- |                    |                     |
|--------------------|---------------------|
| (a) $3 - (-4)$     | (b) $-7 + 2$        |
| (c) $5 - 3$        | (d) $3 - 5$         |
| (e) $-4 - (-4)$    | (f) $-4 - 4$        |
| (g) $5 - (-3) + 4$ | (h) $-4 - (-3) + 5$ |
| (i) $-6 - 4 - 3$   | (j) $-4 + 7 - 5$    |

6. Which choice would make each statement true:  $>$ ,  $<$ , or  $=$ ?

- |   |
|---|
| (a) $-3 - 4 - 5 + 3$ $\blacksquare$ $-4 - 3 - 1 - (-2)$       |
| (b) $4 - 7 + 6 - 8$ $\blacksquare$ $-3 - 5 - (-7) - 4$        |
| (c) $9 - 6 - (-4) - 5$ $\blacksquare$ $5 - 13 - 7 - (-8)$     |
| (d) $5 - 13 + 7 - 2$ $\blacksquare$ $4 - 5 - (-3) - 5$        |
| (e) $7 - 3 - (-15) - 11$ $\blacksquare$ $-7 - 3 - (-11) - 15$ |

7. In each row, which expression has the greatest value? the least value?

- |  |
|--|
| (a) $-5 - 3 + 4$ , $4 - 3 - (-4)$ , $5 - (-3) - 10$    |
| (b) $4 - 3 - 1$ , $-5 - (-2) + 4$ , $-14 + 5 + 6$      |
| (c) $9 - (-2) - 7$ , $5 - (-7) + (-9)$ , $-5 - 3 + 6$  |
| (d) $-6 + 4 + 3 - 2$ , $4 - (-3) - 7$ , $5 - (-2) - 9$ |
| (e) $-5 - 2 + 4$ , $3 - 12 + 2$ , $-7 - (-2) + 1$      |

## Number Sense and Numeracy: Integers—Multiplication and Division

Use a pattern to remember how to multiply or divide integers.

The + and - signs are shown here to remember the rules. In the examples and practise questions, +5 is written as 5.

$$\begin{array}{cccc}
 (-5)(-2) = +10 & (-10) \div (-2) = +5 & (+5)(-2) = -10 & (-10) \div (+2) = -5 \\
 (+5)(+2) = +10 & (+10) \div (+2) = +5 & (-5)(+2) = -10 & (+10) \div (-2) = -5 \\
 \begin{array}{c} \diagdown \quad / \\ \text{same signs} \end{array} & \begin{array}{c} | \\ \text{positive integer} \end{array} & \begin{array}{c} \diagdown \quad / \\ \text{different signs} \end{array} & \begin{array}{c} | \\ \text{negative integer} \end{array}
 \end{array}$$

### Example 1

Find  $3(-2)$ .

#### Solution

$$3(-2) = -6$$

### Example 2

Calculate  $(-2)^3$ .

#### Solution

$$\begin{aligned}
 (-2)^3 &= (-2)(-2)(-2) \\
 &= -8
 \end{aligned}$$

### Example 3

Find  $(-18) \div (-3)$ .

#### Solution

$$(-18) \div (-3) = 6$$

## Practise

1. Find each product.

$$\begin{array}{ll}
 \text{(a)} (-3)(2) & \text{(b)} (-4)(-9) \\
 \text{(c)} (4)(-3) & \text{(d)} (-7)(-3) \\
 \text{(e)} (5)(4) & \text{(f)} (-2)(7)
 \end{array}$$

2. Simplify.

$$\begin{array}{lll}
 \text{(a)} -2(-7) & \text{(b)} -3(8) & \text{(c)} 5(-7) \\
 \text{(d)} -5(-7) & \text{(e)} -4(-9) & \text{(f)} -4(9)
 \end{array}$$

3. Find each quotient.

$$\begin{array}{ll}
 \text{(a)} -18 \div (-6) & \text{(b)} -24 \div 6 \\
 \text{(c)} 51 \div (-17) & \text{(d)} -42 \div (-14) \\
 \text{(e)} -18 \div (18) & \text{(f)} -24 \div (-6) \\
 \text{(g)} 60 \div (-12) & \text{(h)} -30 \div (-15)
 \end{array}$$

4. Simplify.

$$\begin{array}{lll}
 \text{(a)} \frac{-50}{5} & \text{(b)} \frac{-15}{-5} & \text{(c)} \frac{30}{-6} \\
 \text{(d)} \frac{48}{-6} & \text{(e)} \frac{16}{-16} & \text{(f)} \frac{-16}{-8} \\
 \text{(g)} \frac{18}{-9} & \text{(h)} \frac{-81}{27} & \text{(i)} \frac{-18}{-9}
 \end{array}$$

5. Evaluate.

$$\text{(a)} (-4)^2 \quad \text{(b)} (-2)^4 \quad \text{(c)} (-3)^4$$

$$\begin{array}{lll}
 \text{(d)} (-5)^2 & \text{(e)} -5^2 & \text{(f)} 4^3 \\
 \text{(g)} -4^3 & \text{(h)} (-2)^5 & \text{(i)} (-3)^2
 \end{array}$$

6. Simplify.

#### Example:

$$\begin{aligned}
 -3(-2)^4 &= -3(16) \quad \left[ \begin{array}{l} \text{Calculate} \\ \text{powers first.} \end{array} \right. \\
 &= -48
 \end{aligned}$$

$$\begin{array}{ll}
 \text{(a)} -2(-3)^2 & \text{(b)} 4(-2)^3 \\
 \text{(c)} 5(-3)^3 & \text{(d)} (-3)^2(-2)^2 \\
 \text{(e)} -3^2(-2)^3 & \text{(f)} (5)^2(-2)^2 \\
 \text{(g)} -5^2(-3) & \text{(h)} (-5)^2(-3)
 \end{array}$$

7. Calculate.

$$\begin{array}{ll}
 \text{(a)} (-6)^2 \div (-3) & \text{(b)} -6^3 \div (-3) \\
 \text{(c)} -3^4 \div (-3)^2 & \text{(d)} (-4)^3 \div (-2)^3 \\
 \text{(e)} 6^2 \div (-3)^2 & \text{(f)} -4^2 \div (-2)^3 \\
 \text{(g)} 2(-4)^2 \div (-8) & \text{(h)} -8 \div [(-2)(4)] \\
 \text{(i)} -8(-3) \div (-2)^2
 \end{array}$$

8. Calculate.

$$\begin{array}{lll}
 \text{(a)} (5^2 \div 5) \times (7^2 \div 7) & & \\
 \text{(b)} (4^3 \div 2^2) \div (2 \times 2^2) & & \\
 \text{(c)} (-4^3 \times 3) \times (3^2 \div 3) & &
 \end{array}$$

## Number Sense and Numeracy: Order of Operations

When calculating expressions, we follow the order of operations:

### Order of Operations

1. Simplify brackets.
2. Then simplify powers.
3. Multiply and divide.
4. Then add and subtract.

### Example 1

Simplify

$$-3(2 - 4) - (-2 + 4).$$

### Solution

$$\begin{aligned} & -3(2 - 4) - (-2 + 4) \\ & = -3(-2) - (2) \\ & = 6 - 2 \\ & = 4 \end{aligned}$$

### Example 2

Add  $(-3)^2$  to the product of  $-2$  and  $4$ .

### Solution

$$\begin{aligned} & (-2)(4) + (-3)^2 \\ & = (-2)(4) + 9 \\ & = -8 + 9 \\ & = 1 \end{aligned}$$

---

## Practise

1. Simplify. Use the order of operations.
  - (a)  $5 - (3 - 4)$
  - (b)  $(5 - 7) - (3 - 4)$
  - (c)  $-3(-4) - (5 - 7)$
  - (d)  $(3)(2) - (3 + 5)$
  - (e)  $-(5 - 9) - (-2)(2)$
  - (f)  $(4 - 3) - 2(3 - 4)$
  - (g)  $4(-2) - (-8 + 4)$
2. Simplify.
  - (a)  $2(-3)^2 - 4(-2)$
  - (b)  $-4(-2)^3 - 3(-4)^2$
  - (c)  $(-3 - 2)^2 - (2 + 4)^2$
  - (d)  $3(-2 + 4)^3 - 2(-4 + 1)^2$
  - (e)  $2(-1 - 3)^2 - (1 + 3)^2$
  - (f)  $5(-2)^2 - 3(-1 - 2)^3$
  - (g)  $3(-1 - 2) - (5 - 7)^3$
  - (h)  $5(-2 + 1)^3 - (-3 - 2)^2$
  - (i)  $4(1 - 3)^3 - (4 - 7)^2$
  - (j)  $-2(1 - 4)^3 - 3(1 - 5)^2$
3. Match each expression with the corresponding sentence.
  - (a) Find the sum of  $-3$ ,  $-8$ , and  $-2$ .
  - (b)  $-8$  is added to the product of  $-3$  and  $-2$ .
  - (c) Subtract  $-8$  from the product of  $-3$  and  $-2$ .
  - (d) Divide  $-8$  by  $-2$  and add  $-3$ .
  - (e) Decrease the quotient of  $-8$  and  $-2$  by  $-3$ .
    - i.  $-3(-2) + (-8)$
    - ii.  $-8 \div (-2) + (-3)$
    - iii.  $-8 \div (-2) - (-3)$
    - iv.  $-8 + (-3) + (-2)$
    - v.  $(-3)(-2) - (-8)$
4. Increase the sum of  $-3$  and  $5$  by  $-6$ .
5. Divide the sum of  $7$  and  $-16$  by  $-3$ .
6. By how much is the sum of  $-8$  and  $6$  more than  $-4$ ?
7. How much less is the sum of  $-8$  and  $-4$  than the product of  $4$  and  $-2$ ?
8. Divide  $-4^2$  by  $(-2)^2$ .
9. Add  $-3^2$  and  $4^2$  to the product of  $6$  and  $-2$ .
10. Increase the product of  $-7$  and  $-3$  by  $-18$ .
11. By how much is  $(-3 + 5)^2$  more than  $-(-3 + 5)^2$ ?
12. Divide the sum of  $-8$ ,  $-11$ ,  $7$ , and  $-3$  by  $5$ .
13. Divide the sum of  $-4^2$  and  $2^4$  by  $-7^2$ .

Add:  $\frac{7}{10} + \frac{2}{15}$

**Solution**

$$\begin{aligned} \frac{7}{10} + \frac{2}{15} &= \frac{21}{30} + \frac{4}{30} \\ &= \frac{25}{30} \\ &= \frac{5}{6} \end{aligned}$$

Find a common denominator.

Express in lowest terms.

Regroup.

Subtract:  $2\frac{1}{4} - \frac{1}{2}$

**Solution**

$$\begin{aligned} 2\frac{1}{4} - \frac{1}{2} &= 2\frac{1}{4} - \frac{2}{4} \\ &= 1\frac{5}{4} - \frac{2}{4} \\ &= 1\frac{3}{4} \end{aligned}$$

Express in lowest terms.

Regroup.

Multiply:  $\frac{3}{5} \times 1\frac{1}{9}$

**Solution**

$$\begin{aligned} \frac{3}{5} \times 1\frac{1}{9} &= \frac{3}{5} \times \frac{10}{9} \\ &= \frac{1\cancel{2} \times 10^2}{1\cancel{5} \times \cancel{3}} \\ &= \frac{2}{3} \end{aligned}$$

Express in lowest terms. Then multiply.

Divide  $1\frac{2}{3} \div \frac{3}{10}$

**Solution**

$$\begin{aligned} 1\frac{2}{3} \div \frac{3}{10} &= \frac{5}{3} \div \frac{3}{10} \\ &= \frac{5}{3} \times \frac{10}{3} \\ &= \frac{50}{9} \end{aligned}$$

Multiply by the reciprocal.

**Practise**

1. Write the missing information to form equivalent fractions.

- (a)  $\frac{1}{3} = \frac{\blacksquare}{18}$     (b)  $\frac{\blacksquare}{36} = \frac{1}{9}$     (c)  $\frac{\blacksquare}{28} = \frac{4}{7}$
- (d)  $\frac{1}{5} = \frac{7}{\blacksquare}$     (e)  $\frac{3}{8} = \frac{15}{\blacksquare}$     (f)  $\frac{18}{\blacksquare} = \frac{2}{9}$
- (g)  $\frac{1}{\blacksquare} = \frac{9}{36}$     (h)  $\frac{3}{\blacksquare} = \frac{15}{55}$     (i)  $\frac{5}{35} = \frac{\blacksquare}{7}$

2. Add.

- (a)  $\frac{1}{7} + \frac{3}{7}$     (b)  $\frac{2}{9} + \frac{5}{9}$     (c)  $\frac{3}{8} + \frac{1}{8}$
- (d)  $\frac{1}{3} + \frac{1}{9}$     (e)  $\frac{1}{3} + \frac{1}{6}$     (f)  $\frac{1}{3} + \frac{5}{12}$

3. Subtract.

- (a)  $\frac{5}{9} - \frac{1}{9}$     (b)  $\frac{14}{15} - \frac{7}{15}$     (c)  $\frac{7}{15} - \frac{2}{5}$
- (d)  $\frac{5}{6} - \frac{3}{8}$     (e)  $\frac{3}{4} - \frac{1}{6}$     (f)  $\frac{1}{3} - \frac{1}{6}$

4. Add.

- (a)  $1\frac{1}{6} + 2\frac{1}{6}$     (b)  $2\frac{3}{10} + 1\frac{3}{10}$
- (c)  $3\frac{3}{4} + 1\frac{3}{4}$     (d)  $1\frac{3}{4} + 2\frac{5}{12}$
- (e)  $2\frac{1}{6} + 1\frac{5}{6}$     (f)  $4\frac{2}{5} + 3\frac{1}{5}$

5. Subtract.

- (a)  $3\frac{5}{9} - 1\frac{2}{9}$     (b)  $4\frac{7}{16} - 2\frac{3}{16}$
- (c)  $3\frac{3}{10} - 1\frac{7}{10}$     (d)  $2 - 1\frac{1}{4}$
- (e)  $5\frac{1}{11} - 4\frac{9}{11}$     (f)  $2\frac{3}{7} - 1\frac{6}{7}$

6. Multiply.

- (a)  $\frac{1}{2} \times \frac{3}{5}$     (b)  $\frac{3}{4} \times \frac{7}{10}$
- (c)  $\frac{3}{5} \times 15$     (d)  $\frac{2}{3} \times \frac{9}{11}$
- (e)  $\frac{3}{4} \times \frac{8}{15}$     (f)  $2\frac{1}{3} \times \frac{3}{14}$

7. Divide.

- (a)  $\frac{3}{7} \div \frac{4}{5}$     (b)  $\frac{2}{11} \div \frac{3}{5}$
- (c)  $\frac{3}{4} \div \frac{7}{8}$     (d)  $\frac{5}{8} \div \frac{13}{16}$
- (e)  $2 \div \frac{2}{3}$     (f)  $4 \div \frac{8}{9}$
- (g)  $\frac{3}{4} \div 9$     (h)  $\frac{5}{7} \div 10$

8. Arrange the fractions in order from least to greatest in value.

- (a)  $\frac{3}{4}, \frac{5}{8}, \frac{1}{2}$     (b)  $\frac{7}{8}, \frac{3}{4}, \frac{13}{16}$
- (c)  $\frac{3}{5}, \frac{9}{10}, \frac{3}{4}$     (d)  $\frac{5}{6}, \frac{8}{9}, \frac{2}{3}$