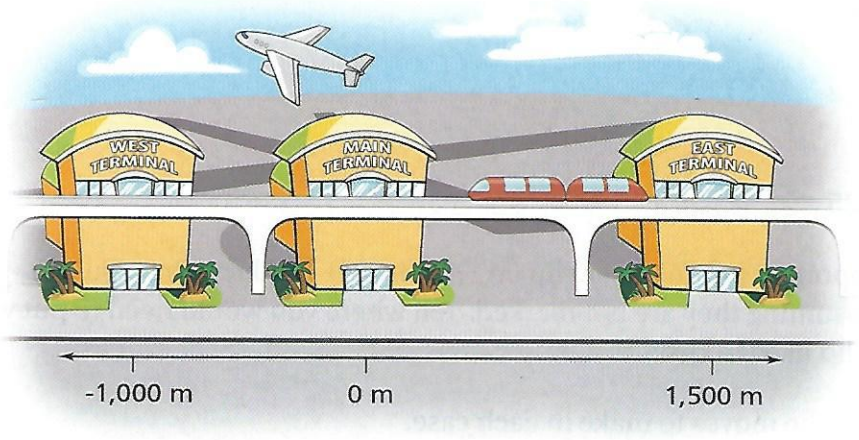
Applications

1. At some international airports, trains carry passengers between the separate terminal buildings. Suppose that one such train system moves along a track like the one below.



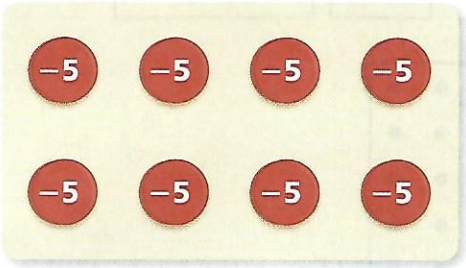
a. A train leaves the main terminal going east at 10 meters per second. Where will it be in 10 seconds? When will it reach the east terminal?

b. A train passes the main terminal going east at 10 meters per second. Where was that train 15 seconds ago? When was it at the west terminal?

c. A train leaves the main terminal going west at 10 meters per second. Where will it be in 20 seconds? When will it reach the west terminal?

d. A train passes the main terminal going west at 10 meters per second. When was it at the east terminal? Where was it 20 seconds ago?

2. Julia thinks a bit more about how to use red and black chips to model operations with integers. She draws the following chip board. She decides it represents $8 \times (-5) = -40$ and $-40 \div 8 = -5$. Explain why Julia's reasoning makes sense.



Use Julia's reasoning from Exercise 2 to find each value.

3. $10 \times (-5)$

4. $4 \times (-15)$

5. $3 \times (-5)$

6. $-14 \div 2$

7. $-14 \div 7$

8. $-35 \div 7$

9. Find each product.

a. $7 \cdot 2$

b. $-7 \cdot (-2)$

c. $7 \cdot (-2)$

d. $-7 \cdot 2$

e. $8 \cdot 2.5$

f. $-9 \cdot (-4)$

g. $12 \cdot (-3)$

h. $-1.5 \cdot 4$

i. $3.5 \cdot 7$

j. $-8.1 \cdot (-1)$

k. $1 \cdot (-6)$

l. $-2\frac{1}{2} \cdot 1$

10. Tell whether each product is greater than or less than zero.

a. $5 \cdot (-7)$

b. $-3.2 \cdot 1.5$

c. $10.5 \cdot (-4)$

d. $-2 \cdot (-3) \cdot (-1)$

e. $-\frac{2}{3} \cdot 2\frac{3}{4}$

f. $-\frac{3}{4} \cdot \left(-1\frac{5}{6}\right) \cdot \left(-\frac{7}{4}\right)$

g. $-\frac{3}{4} \cdot \left(-1\frac{5}{6}\right) \cdot \frac{7}{4}$

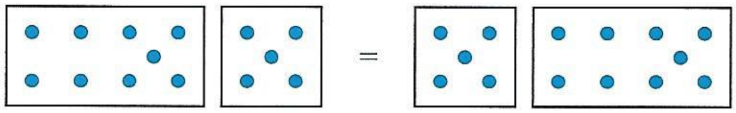
h. $-\frac{3}{4} \cdot \left(-1\frac{5}{6}\right) \cdot \left(-\frac{7}{4}\right) \cdot \left(-2\frac{3}{8}\right)$

i. $\frac{3}{4} \cdot \left(-1\frac{5}{6}\right) \cdot \frac{7}{4} \cdot \left(-2\frac{3}{8}\right)$

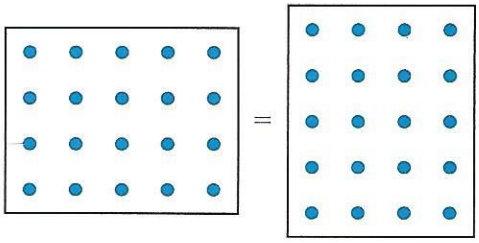
j. $\frac{3}{4} \cdot 1\frac{5}{6} \cdot \frac{7}{4} \cdot \left(-2\frac{3}{8}\right)$

The dot patterns illustrate commutative properties for operations on whole numbers. Write a number sentence for each case.

11.



12.



13. Find the values for each pair.

a. $4 \cdot (-3)$ and $-3 \cdot 4$

b. $2 \cdot (-4)$ and $-4 \cdot 2$

c. $-2 \cdot (-3)$ and $-3 \cdot (-2)$

d. $\frac{1}{5} \cdot \left(-\frac{4}{9}\right)$ and $-\frac{4}{9} \cdot \frac{1}{5}$

e. What can you conclude about multiplication with negative numbers?

14. You have located fractions such as $-\frac{5}{7}$ on a number line. You have also used fractions to show division: $\frac{-5}{7} = -5 \div 7$ and $\frac{5}{-7} = 5 \div (-7)$. Tell whether each statement is *true* or *false*. Explain.

a. $\frac{-1}{2} = \frac{1}{-2}$

b. $-\frac{1}{2} = \frac{-1}{-2}$

15. For each number sentence, find a value for n that makes the sentence true.

a. $24 \div 2 = n$

b. $-24 \div (-2) = n$

c. $24 \div n = -12$

d. $n \div 2 = -12$

e. $5 \div 2.5 = n$

f. $-12 \div n = 3$

g. $n \div (-3) = -4$

h. $(-16) \div \frac{1}{4} = n$

For Exercises 16–18, write four related multiplication and division facts for each set of integers.

Sample 27, 9, 3

$9 \cdot 3 = 27$

$3 \cdot 9 = 27$

$27 \div 9 = 3$

$27 \div 3 = 9$

16. 7, −3, −21 **17.** −4, −5, 20 **18.** 1.5, −3, −4.5

For Exercises 19–24, determine whether the product of or quotient of each expression is greater than, less than, or equal to 0 without doing any calculations. Explain your reasoning.

19. $-1{,}105.62 \div 24.3$

20. $0 \cdot (-67)$

21. $-27.5 \cdot (-63)$

22. $0 \div 89$

23. $-54.9 \div (-3)$

24. $-2{,}943 \cdot 1.06$

25. Use the multiplication and division algorithms you developed to find each value.

a. $12 \cdot 9$

b. $5 \cdot (-25)$

c. $-220 \div (-50)$

d. $48 \div (-6)$

e. $-63 \div 9$

f. $\frac{2}{-3} \cdot \left(\frac{-4}{5}\right)$

g. $\frac{-99}{33}$

h. $-2.7 \div (-0.3)$

i. $-36 \cdot 5$

j. $52.5 \div (-7)$

k. $-2\frac{1}{2} \cdot \left(-\frac{2}{3}\right)$

l. $9 \div 5$

m. $-9 \cdot (-50)$

n. $\frac{-96}{24}$

o. $6 \cdot 1\frac{1}{2}$

p. $-\frac{5}{8} \cdot \frac{8}{5}$

q. $4 \cdot \left(-1\frac{1}{4}\right)$

r. $-2.5 \cdot 2\frac{1}{5}$