Operations with Integers: PreAlgebra

Students often have a tough time with integer operations. To help them succeed, consider using a real-world example. The use of money and debt seems to help most college-level students.

Supplies: Play Money
Play Debt

Through the use of money and debt, you can show addition, subtraction, and multiplication. Division can be defined by use of the multiplication rules.

Rules of the Game: **Money** is a **positive** value. **Giving** is an **addition** symbol.
Debt is a **negative** value. **Taking** is a **subtraction** symbol.

ADDITION OF INTEGERS

Rule: To add two integers with the same sign, add the absolute values of the integers, and give the result the common sign.

The rule for adding two integers with the same sign can be explained by using the following two examples:

(1) A student begins with \$10, and you give him \$5.

$^{+}10 + {}^{+}5 = {}^{+}15$

If a student starts with \$10 and gets \$5 more, he is \$15 to the good.

(2) A student begins with \$10 of debt, and you give him \$5 of debt.

$^{-}10 + {}^{-}5 = {}^{-}15$

If a student starts with \$10 of debt and gets \$5 more debt, he is \$15 in debt.

Rule: To add two integers with different signs, subtract the smaller absolute value from the larger absolute value. Give the result the original sign of the larger absolute value.

The rule for adding two integers with different signs can be explained by using the following two examples:

(1) A student begins with \$10 of debt, and you give him \$5.

$^{-}10 + {}^{+}5 = {}^{-}5$

If a student starts with \$10 of debt and gets \$5 to help pay off some of his debt, he is now only \$5 in debt.

(2) A student begins with \$10, and you give him \$5 of debt.

$^{+}10 + {}^{-}5 = {}^{+}5$

If a student starts with \$10 and gets \$5 of debt, he now has \$5.

SUBTRACTION OF INTEGERS

Rule: To subtract two integers, rewrite the subtraction as addition of the opposite sign.

$$a - b = a + (^{-}b)$$

Since you now have an addition problem, you can go back to the addition rules.

The rule for subtracting integers can be explained by using the following examples:

(1) A student begins with \$10, and you take away \$5.

$$^{+}10 - {}^{+}5 = {}^{+}10 + {}^{-}5 = {}^{+}5$$

If a student begins with \$10 and has \$5 taken away, this is the same as starting with \$10 and being given a \$5 debt. The student will end up with \$5.

(2) A student begins with \$10, and you take away a \$5 debt.

$$^{+}10 - {}^{-}5 = {}^{+}10 + {}^{+}5 = {}^{+}15$$

If a student begins with \$10 and has a \$5 debt taken away, this is the same as starting with \$10 and being given \$5. Either way, \$5 extra is in the picture. The student will end up with \$15.

*Overall, subtracting a positive will make the original number smaller, while subtracting a negative with make the original number larger.

Rules of the Game: **Money** is a **positive** value. **Giving** is a **positive** value.
Debt is a **negative** value. **Taking** is a **negative** value.

MULTIPLICATIN OF INTEGERS

Rule: To multiply two integers,
1. if same sign, the result will be positive.
2. if different signs, the result will be negative.

Note: Students need to recall that multiplication represents repeated addition.

$2 \bullet 3 = 3+3 = 6$

$5 \bullet 1 = 1+1+1+1+1 = 5$

The rule for multiplying integers can be explained by using the following examples.

(1) A student is twice given \$10.

$^{+}2 \bullet {}^{+}10 = {}^{+}20$

If a student is twice given \$10, he ends up with \$20.

(2) A student is twice given a \$10 debt.

$^{+}2 \bullet {}^{-}10 = {}^{-}20$

If a student is twice given a \$10 debt, he ends up with \$20 of debt.

(3) I twice take \$10 away from a student.

$^{-}2 \bullet {}^{+}10 = {}^{-}20$

If I twice take \$10 from a student, he is down \$20.

(4) I twice take \$10 of debt away from a student.

$^{-}2 \bullet {}^{-}10 = {}^{+}20$

If I twice take a \$10 from a student, he is better off by \$20. He now doesn't have to pay off the debts.

DIVISION OF INTEGERS

Rule: To divide two integers,
1. if same sign, the result will be positive.
2. if different signs, the result will be negative.

Note: I suppose you could get fancy with division as we did with multiplication, but I usually find that it is enough to define division based off of multiplication. In other words, $6 \div 3 = 2$ because $2 \bullet 3 = 6$.

Find $^{-}10 \div {}^{-}2$.

What number, when multiplied with $^{-}2$, will give us $^{-}10$?

The answer must be $^{+}5$, since $^{-}2 \bullet {}^{+}5 = {}^{-}10$.

To use the rule for division:

$^{-}10 \div {}^{-}2$

$= {}^{+}5$

The answer would be positive five, since we were dividing the same signs and ten divided by two is five.

Note: A student will be exam-ready when he or she can do all four integer operations in any order.

Simplify.

(1) $-5+12$ (2) $\dfrac{40}{-2}$ (3) $2-9$

(4) $^{-}3 \bullet {}^{-}9$ (5) $^{-}1 - {}^{-}4$ (6) $^{-}50 \div {}^{-}1$

(7) $^{-}2 + {}^{-}4$ (8) $10 \bullet {}^{-}10$ (9) $^{-}5+0$

answers: **(1)** 7 **(2)** -20 **(3)** -7 **(4)** 27

(5) 3 **(6)** 50 **(7)** -6 **(8)** -100 **(9)** -5