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3.6a

Attack & Defense: The Game of Integers **(Answer Key)**

What Are Integers?

Before we talk about integers, let’s review whole numbers. What are some examples of whole numbers?

 Whole number examples: Whole number NON-examples:

 **1** $1\frac{1}{2}$

 **5 5.1**

 **6.00000 6.00001**

 **8,234 8.234**

 **10 ÷ 5 10 ÷ 3**

 **1,000,000 1,000,000.9**

Integers are just like whole numbers, but they also include negatives. What are some examples?

Integer examples: Integer NON-examples:

  **-1** $-1\frac{1}{2}$

 **1**

**5 5.1**

 **-5**

 **{…-2, -1, 0, 1, 2,…}**

Whole-Class Discussion

We’ll use integers to play a game called Attack & Defense. What will make your score go up, positive chips or negative chips? \_\_**positive**\_\_\_\_\_\_\_\_. What will make your score go down? \_\_\_**negative**\_\_\_\_\_\_\_\_\_.

Here’s how we’re going to draw pictures of positive and negative chips:

5

0

-5

Example:

3 negative chips

5

0

-5

**Practice**: Show 4 positive chips

5

0

-5

**Practice:** Show ‑4 chips plus -1 chip

If the number of Positives you have is the same as the number of Negatives, then your total chips is 0.

1). What are some combinations of chips would give you a total of 0? Draw 2 examples:
 **Answers will vary. Sample answers:**

5

0

-5

5

0

-5

Equation: **3 + -3 = 0**

Equation: **-1 + 1 = 0**

**Lines crossing out the chips show pairs of positives and negatives canceling.**

 For each Pos. that you add, your total goes up by 1.

 For each Pos. you take away, what do you think happens? \_**your total goes down**\_\_\_\_\_\_

 When you add a Neg. to your chips, does your total go up or down?\_\_**down**\_\_\_\_\_

 But if you take away a Neg., what do you think happens? \_\_\_**your total goes up**\_\_\_\_

What are some ways you could lower your total by 2 chips? **Answers will vary. Samples:**

2).

What are some ways you could raise your total by 3 chips? **Answers will vary. Samples:**

3).

a). **Add 2 negative chips.**

b). **Add 3 negatives and 1 pos.**

c). **Add 5 pos and 7 neg.**

d). **Take out 2 pos.**

a). **Add 3 positive chips.**

b). **Add 4 positives and 1 neg.**

c). **Add 7 negatives and 10 pos.**

d). **Take out 3 negative chips.**

4). Let’s say you had 2 Pos and added 5 Neg. Then your new total would be -3, since the 2 Pos chips would cancel out 2 Neg chips, leaving 3 Neg chips at the end. We can draw a picture of it like this:

5

0

-5

Equation: **2 + -5 = -3**

**3 Neg. chips are left.**

5

0

-5

5

0

-5

Eq’n: **-1 + 3 = 2**

Eq'n: **4 + -2 = 2**

5).

What are some combinations of chips that make a total of +2? Please give two examples.

6).

What are some combinations of chips that make a total of -6? Please give two examples:

.

5

0

-5

5

0

-5

Eq’n: **-4 + -2 = -6**

Eq’n: **-7 + 1 = -6**

10

10

-10

-10

**Answers will vary. Samples are shown.**

**2**

**2**

**-6**

**-6**

Small-Group Practice:

6). For each situation below, draw a picture and write the equation.

5

0

-5

5

0

-5

Eq’n: **9 + -4 = 5**

Eq’n: **-4 + -8 = -12**

10

10

-10

-10

a).

You add 3 Pos chips and 5 Pos chips:

5

0

-5

5

0

-5

Eq’n: **3 + 5 = 8**

Eq’n: **4 + -9 = -5**

10

10

-10

-10

b).

You add 4 Pos chips and 9 Neg chips:

c).

You add 9 Pos chips and 4 Neg chips:

d).

You add 4 Neg chips and 8 Neg chips:

**-5**

**5**

**Add up:**

**8**

**Add up:**

**-12**

Practice on Your Own.

8). Try these questions on your own. Each answer will be shown after you have a chance to work.

5

0

-5

Eq’n: 10 + 6 = \_**16**\_

10

-10

5

0

-5

5

0

-5

Eq’n: -3 + -6 = \_**-9**\_

Eq’n: 8 + -5 = \_**3**\_

10

10

-10

-10

**Add up:**

**-9**

**3**

Small-Group Inquiry

9). In the pictures in #7-8, **sometimes some chips** **CANCEL** out, and **sometimes they all ADD UP**.

 a). Describe all the situations in which some chips *cancel out*. Use a complete sentence in your answer.

 **They cancel out when you have some negatives and some positives.**

 b).Describe all the situations in which the amounts of chips *add up*. Use a complete sentence in your answer.

 **They add up when you have both positives, or both negatives.**

10). a). In the first box below, make up an example where the amounts add up. Label the example “Amounts Add Up.”

b). In the next box, make up an example where they cancel part of each other out. Label it “Amounts Partially Cancel.”

**2 Kinds of Integer Addition Problems**

Label:

 Amounts \_\_**Add Up**\_\_\_

5

0

-5

Eq’n: **-4 + -6 = -10 (sample)**

Label:

 Amounts \_\_**Partially Cancel**\_\_\_\_

5

0

-5

Eq’n: **6 + -4 = 2 (sample)**

**2**

11). a). If the amounts are going to cancel out, how can you calculate how much will be left? For example, if you had 437 chips of one kind, and 922 chips of the other kind, how many would be left after they canceled part of each other out? Show work and explain your reasoning.

 **You have to subtract them if they cancel out. So you would do 922-437, which means there would be 485 chips left.**

b). In part a), how do you know whether what’s left will be Pos chips or Neg chips? Use a complete sentence in your answer.

 **It depends on which type of chips had more to start with. Whichever had more, that’s what will be left.**

c). Of the expressions below, circle the one in which the chips will *cancel part of each other out*. In a complete sentence, explain your reasoning.

 77 + 245 -932 + -58 -68 + 250

 d). In the problem you circled, after the chips cancel part of each other out, how much will be left, and will it be positive or negative? Use a complete sentence in your answer.

 **There will be 182 chips left at the end (I got that by doing 250-68). They will be positive, because there were more positive chips to start with (250 is greater than 68).**

12).a). Write your own addition problem in which the amounts *add up* and give a *negative answer*.

(You don’t have to solve it yet.)

 **Sample: -45 + -10**

 b). Now solve your addition problem.

 **Sample: -45 + -10 = -55**

13).a). Write your own addition problem in which the amounts *add up* and give a *positive answer*.

(You don’t have to solve it yet.)

 **Sample: 22 + 11**

 b). Now solve your addition problem.

 **Sample: 22 + 11 = 33**

14).For each addition problem, please fill in the table.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Addition Problem | Do the chips add up, or cancel out? | How many chips are left at the end? | Is what’s left Positive or Negative? | What’s the sum? |
| -8 + -21 | **Add up** | **29** | **Neg** | **-29** |
| -8 + 21 | **Cancel** | **13** | **Pos** | **13** |
| +8 + -21 | **Cancel** | **13** | **Neg** | **-13** |
| +19 + -13 | **Cancel** | **6** | **Pos** | **6** |
| -19 + 13 | **Cancel** | **6** | **Neg** | **-6** |
| -19 + -13 | **Add up** | **32** | **Neg** | **-32** |
| 19 + +13 | **Add up** | **32** | **Pos** | **32** |

15).Now practice with larger amounts.

 -88 + 213

 a). Do the chips add up, or cancel out? \_\_\_**Cancel out**\_.

 b). How many chips will there be at the end? Show your scratch work below:

 **(Show scratch work of computation for**

 **213**

**– 88**

 **125**

 c). When you wrote the scratch work in part b), did it matter whether you put 88 or 213 on top? Why or why not?

**Yes, it mattered, because you can’t set up scratch work for subtraction with the smaller number on top. You can’t do this:**

 **88**

**– 213**

 d). Will the sum be positive or negative? \_\_\_\_**Pos**\_\_\_\_\_\_\_.

 e). What’s the sum? \_\_**125**\_\_\_.

16). When you have to do scratch-work to subtract two positive numbers, the larger number has to be on top, like this:

Example:

4 5 1

2 8

 –

Non-Example:

4 5 1

2 8

 –

Question: How do these examples relate to #15? Please answer in a complete sentence.

**In #15, we had to put the 213 on top, even though it was the second number in the problem (the problem said -88 + 213).**

17). Please calculate each answer. SHOW SCRATCH WORK for each question. Please circle your answers, and don’t forget to put a negative sign on them if they’re negative.

 a). -88 + -213 b). 54 + -400 c). 355 + -198

  **88 400 355**

 **+ 213 –** **54 – 198**

 **301 346 157**

 **-301 -346 157**

18).Try these problems.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Addition Problem | Do the chips add up, or cancel out? | How many chips are left at the end? **Show scratch work!** | Is what’s left Positive or Negative? | What’s the sum? |
| -80 + 210 | **Cancel** | **130** | **Pos** | **130** |
| -42 + -214 | **Add up** | **256** | **Neg** | **-256** |
| -6,532 + 412 | **Cancel** | **6120** | **Neg** | **-6120** |
| 1,258 + -1,875 | **Cancel** | **617** | **Neg** | **-617** |
| +195 + -137 | **Cancel** | **58** | **Pos** | **58** |
| -169 + -474 | **Add up** | **643** | **Neg** | **-643** |
| 857 + -1,388 | **Cancel out** | **531** | **Neg** | **-531** |