Integers

➢ Integers are **whole numbers** and their **opposites.**

...., -4, -3, -2, -1, 0, 1, 2, 3, 4, ...

- The dots showing that the set of integers is **infinite** (never ending).
- The numbers **below** zero (0) or the **left side** of zero are **negative integers.**
- The numbers **above** zero (0) or the **right side** of zero are **positive integers.**
- Integers such as **-4** and **+4** are **opposites.**
- The "**+**" is often referring to **positive** integers.

❖ **Integers and the number line**

➢ Integers can be shown on a **number line.**

- Numbers are represented in order of size **from left to right**.
- The **further right** the number is on the number line, the **larger the number**.

LEFT   RIGHT

-4   -3   -2   -1   **0**   1   2   3   4
Negative integers   **zero**   Positive integers
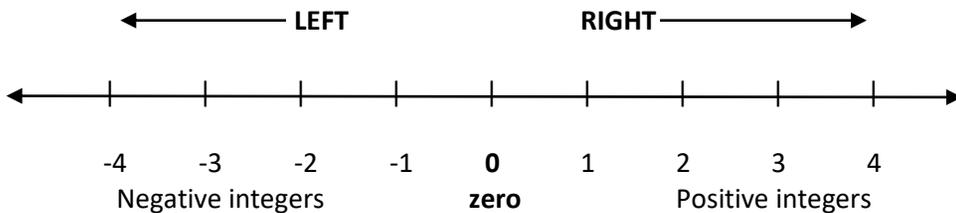
- The number line makes it easy to compare the sizes of numbers.

Example:
i. Put the integers 4, -3, 2, -2, 0, -4 in the correct place on a number line.

-4   -3   -2   0   2   4
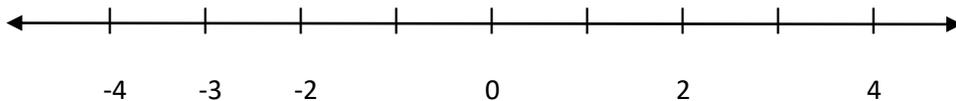
ii. Insert the correct symbol in the space between the integers, < or >, to make each statement true.
a) -18 ____ -15
(You can draw a number line to check your answer).
- On the number line, -18 is to the **left** of -15, therefore **-18 < -15**

b) 7 ____ 6
- On the number line, 7 is to the **right** of 6, therefore **7 > 6**

c) -12 ____ -13
- On the number line, -12 is at the **right** of -13, therefore **-12 > -13**

Activity 2.1
1. Draw a number line and insert the following numbers into it.
a) -4, 3, -2, 5, 1

b) -10, -3, 1, -7, 0

2. Write the following sets of integers in the correct order, from smallest to largest.
a. 6, 10, 7, 13, 2
b. -3, -7, -2, -6, -10
c. 4, -6, -8, 3, 12
d. -35, -36, -30, -31, -33

3. Insert the correct symbol < or > in the space between the integers to make the following statements true.
a. -6 ____ 7   b. 7 ____ 6   c. 10 ____ -11
d. -35 ____ -15   e. 3 ____ -5   f. 12 ____ -12

❖ Adding and Subtracting Positive Integers

➢ To add or subtract positive integers using a number line:
- Count to the right if adding (to get a larger number); and
- Count to the left if subtracting (to get a smaller number).

Step 1: Start at the position of the first number.
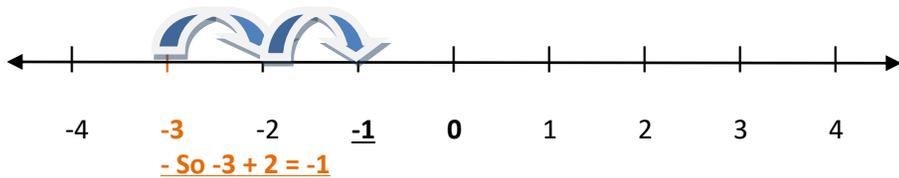**Step 2:** Move according to the size and sign of the next number.

- **Positive** sign move **right.**
- Negative sign move **left.**
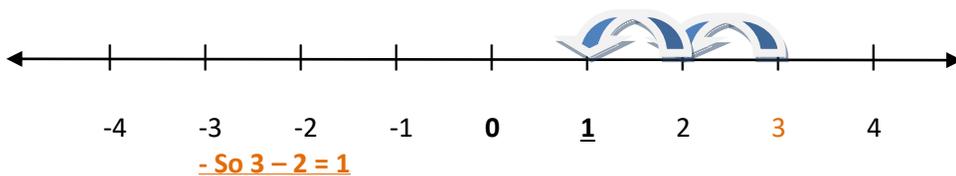Your **answer** will be the number you **end up at**.

Example:
i. -3 + 2

- Start at -3 and move 2 to the right to end up at -1.

-4   **-3**   -2   **-1**   **0**   1   2   3   4
- So -3 + 2 = -1

ii. 3 – 2

- Start at 3 and move 2 to the left to end up at 1.

-4   -3   -2   -1   **0**   **1**   2   3   4
- So 3 – 2 = 1

❖ Adding and Subtracting Negative Integers

- **Adding** a **negative integer** means **move left along the number line**. So adding a negative means **'subtract' (-).**

Example:
i. **3 + -2** means the **same** as **3 – 2 = 1**

ii. **6 + - 2** means the **same** as **6 – 2 = 4**

- **Subtracting** a **negative integer** signs, can be **replaced** with a **single positive sign** so **'add' (+).**

Example:
i. **3 - -2** means the same as **3 + 2 = 5**

ii. **6 - -3** means the **same** as **6 + 3 = 9**

- **When there are two signs (+,-) together, they need to be replaced with a single (one) sign.**
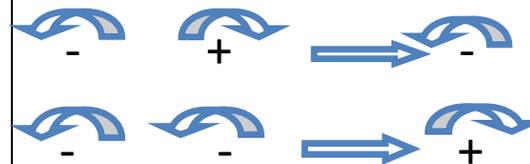(Ko e taimi 'oku tu'u fakataha ai e ongo faka'ilonga (+,-) 'e fiema'u leva ke fakafofonga'I'aki pe ha fo'I faka'ilonga pe 'e taha).

- If the **two signs** are the **same** (+ + or - -) then **ADD (+).**
(Kapau 'e fakatou tatau pe ongo faka'ilonga (++ pe --) pea 'e Tanaki leva (+).
- If the **two signs** are **different** (+ - or - +) then **SUBTRACT (-).**
(Kapau 'e kehekehe leva e ongo faka'ilonga (+ - pe - +) pea 'e Kole leva (-).

-    +   ⟹   -

-    -   ⟹   +

❖ **Adding and Subtracting Larger Integers**

➢ When the integers get large it becomes impractical to draw a number line. Instead imagine a number line in your head and use the same steps as before.
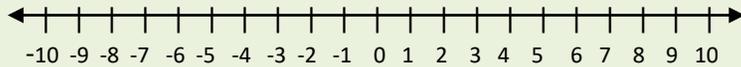
Example:
i. Calculate -43 - -51
-43 - -51 = -43 + 51 or 51 - 43
= **8**

ii. Calculate 78 + -92
78 + -92 = 78 – 92
= **-14**

Activity 2.2
1. Copy the number line shown below and use arrows to complete the following additions and subtractions of integers.

-10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8 9 10

a. -5 + 2	b. -4 + 3	c. -10 + 9	d. – 9 + 10
e. 5 – 6	f. 3 – 8	g. -3 – 4	h. -6 – 3

2. Using a number line, or otherwise calculate the following.
a. -2 – 3 – 8	b. 4 – 8 + 5	c. 1 – 8 + 2
d. 3 – 2 + 7	e. -8 + 5 – 3	f. -1 + 5 + 3

3. Without using a calculator, calculate the following.
a) -38 + 28	b) -51 + 87	c) -110 + 80
d) -94 + 28	e) -79 + 100	f) 36 + 45

4. Rewrite the following with a single sign then calculate.
a) 9 + -3	b) 6 + -7	c) 3 + -5
d) 7 + -10	e) 8 + -8	f) -8 + -10
g) 7 - -5	h) 9 - -9	i) 6 - -15

j) 3 - -10	k) -7 - -8	l) -2 - -3
m) – 66 - -18	n) 87 + -23	o) 45 - -39
p) -61 + -59	q) 35 + -44	r) -23 + -47

❖ **Multiplication of Integers**

➢ Multiplication is a **short way** of doing **repeated additions.**

Example: **-3 x 5** is the **same** (tatau) as **(-3) + (-3) + (-3) + (-3) + (-3) = -15**

- When multiplying two integers with the same sign (both + or both -) the answer is positive.
(Koe taimi 'oku tatau ai e faka'ilonga (nekativi pe positivi) 'e positive ma'upe e mo'oni / tali).

Example:
i. **3 x 5 = 15**
(Positivi e 3 pea positive mo e 5, koia ai 'oku **tatau** e faka'ilonga, liunga kinaua 'o ma'u ai e **positivi** 15).

ii. **-3 x -5 = 15**
(Nekativi e 3 (-3) pea nekativi mo e 5 (-5), **tatau** e faka'ilonga, liunga naua 'o ma'u ai e **positivi** 15).

- When multiplying two integers with the different signs (+ and -) the answer is negative.
(Ko e taimi 'oku **kehekehe** ai e faka'ilonga (nekativi mo e positivi) 'e **nekativi** ma'upe 'a e mo'oni / tali).

Example:
i. **8 x -5 = -40**
(Positivi e 8 mo e nekativi 5 (-5), 'oku **kehekehe** hona faka'ilonga, koia ai 'e liunga ki naua 'o ma'u ai e **nekativi** 40 (-40).
ii. **-3 x 5 = -15**

(Nekativi 3 (-3) mo e positive 5 (5), **kehekehe** hona faka'ilonga, liunga kinaua 'o ma'u ai e **nekativi** 15 (-15).

❖ Division of Integers

➤ Division of Integers follows the **same rules as multiplication.**
- When the **two signs** are the **same** (both + or both -) then the answer is **'positive'**.
- When the **two signs** are **different** (+ and -) then the answer is **'negative'**.

Example:
i. -12 ÷ -6
= 2
(Fakatou nekativi loua e 12 (-12) mo e 6(-6), **tatau** hona faka'ilonga, koia ai 'e **positive** leva e mo'oni/tali)

ii. 12 ÷ -6
= -2
(Positivi e 12 kae nekativi e 6 (-6), koia ai 'oku **kehekehe** hona faka'ilonga, 'e **nekativi** leva e mo'oni/tali)

❖ Order of Operations

➤ Integers follow the same **BEDMAS** rules as whole numbers.

Brackets	()
Exponents	2^2
Division	÷
Multiplication	x
Addition	+
Subtraction	-

Example: Evaluate the following

i. 5 x 3 – 12 x 2 + 15
5 x 3 – 12 x 2 + 15 [first do the first multiplication, **5 x 3 = 15**]
= 15 – 12 x 2 + 15 [do the next multiplication, **12 x 2 = 24**]
= 15 – 24 + 15 [first addition or subtraction is **15 – 24 = -9**]
= -9 + 15 [lastly, **-9 + 15 = 6**]
= 6

ii. (12 – 20) ÷ (3 - -1)
(12 – 20) ÷ (3 - -1) [do the first bracket, **12 – 20 = -8**]
= -8 ÷ (3 - -1) [do the last bracket, **3 - -1 = 4**]
= -8 ÷ 4 [lastly, **-8 ÷ 4**]
= -2

Activity 2.3
1. Calculate the following.
a) 6 x 7   b) -6 x 7   c) -6 x -7   d) 6 x -7
e) 12 ÷ -3   f) -56 ÷ 7   g) 40 ÷ -10   h) -48 ÷ -8
i) 3 x 4 x 5   j) -3 x 4 x 5   k) -3 x -4 x -5   l) 7 x -4 x -8

2. Fill in the spaces to make the equations correct.
a. 6 x ___ = -36   b) -4 x ___ = -20   c) -9 x ___ = -9
d) 30 x ___ = -120   e) ___ x -7 = -49   f) -3 x ___ = 0

Activity 2.4
1. Calculate the following by follows the order of operations.
a) 9 x 12 ÷ 6   b) 4 x -12 ÷ 6
c) 48 ÷ -6 x -6   d) 6 – 8 ÷ 4
e) 7 + -8 x -9   f) 6(-7 + 9)
g) 12 – (7 + -6)   h) -27 ÷ -9 x 5
i) (14 - -9) x -8   j) (10 + -4) – (3 - -5)

Activity 2.5

1. Early one morning two climbers saw on their thermometer that the temperature was -11 ^{O}C.
By midday the temperature had risen/increased by 16 ^{O}C.
By evening the temperature had fallen/decreased again to -8 ^{O}C.
a. What was the temperature at midday?

b. By how many degrees had the temperature fallen/decreased between midday and the evening?

2. Nathan has an overdraft at the bank of $200. His mother gives him $250, how much does he have in the bank now?

3. Leon has an overdraft at the bank of $650. If he pays in $1 000, how much money does he have in the bank now?