

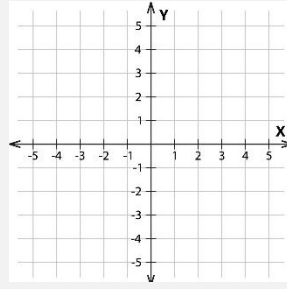
# Lesson 1 – Order of Operations

## Starter

1) Draw the following graphs:

a)  $x = 2$

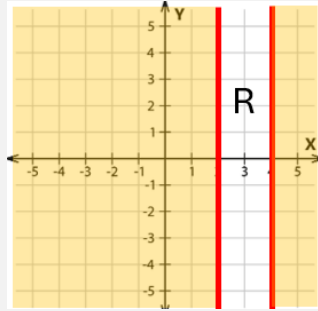
b)  $x = 4$



2) Now label the region with an R that satisfies the inequality

$$2 \leq x \leq 4$$

## Starter Answers



## The Addition and Subtraction Group

We think of **addition** and **subtraction** as **one group**. One doesn't come before the other, we can swap the order if we want to.

For example, consider the calculation:  
It has two operations, +4 and -7

$$11 + 4 - 7$$

We could add 4 first then subtract 7:

$$11 + 4 = 15$$

$$15 - 7 = 8$$

Alternatively, we could subtract the 7 first:

$$11 - 7 = 4$$

$$4 + 4 = 8$$

## Example 1

Which of these calculations would have the same value as  $25 - 9 + 8$ ?

A:  $25 + 8 - 9$

B:  $25 - 8 + 9$

C:  $-9 + 25 + 8$

## Answer

$$25 - 9 + 8$$

A:  $25 + 8 - 9$

This has the same two operations, just in a different order. So this will give the same answer

B:  $25 - 8 + 9$

This has two different operations so will not give the same answer.

C:  $-9 + 25 + 8$

We could rewrite this as  $25 - 9 + 8$  which is the same as the one in the question.

When we **subtract**, we can **simplify** the calculation by doing the subtractions in a slightly different order.

Consider the calculation:  $12 - 2 - 3$

If you subtract 2 and then subtract 3, you have subtracted 5 in total.  
So we can change the calculation to  $12 - 5$

### **Example 2**

Which of these calculations is equivalent to  $15 - 7 - 2$ ?

- A:  $15 - 5$
- B:  $15 - 9$
- C:  $-7 - 2 + 15$
- D:  $7 - 15 - 2$

### **Answer**

- A: We can't do the  $7 - 2$  first because there isn't a bracket around the  $7 - 2$ . So this would not be the same.
- B: Subtracting 7 and then subtracting 2 is the same as subtracting 9 in total. So B is the same.
- C: This calculation has the same operations as the one in the question. Therefore we could re-write it as  $15 - 7 - 2$ .
- D: This is not the same. In the original, we were subtracting 7 but in the new one we are not (since 7 is positive). We are actually subtracting 15 instead.

### **The Multiplication and Division Group**

**Multiplication** and **division** also come as a group. Just like we did with addition and subtraction, we can switch the order around.

For example, consider the calculation:  $12 \div 2 \times 3$   
This has two operations,  $\div 2$  and  $\times 3$

We could divide by 2 first, then times by 3:  $12 \div 2 = 6$   
 $6 \times 3 = 18$

Alternatively, we could  $\times 3$  first then  $\div 2$ :  $12 \times 3 = 36$   
 $36 \div 2 = 18$

### Example 3

Which calculation is equivalent to  $24 \div 3 \times 6 \div 4$ ?

- A:  $24 \div 4 \times 6 \div 3$
- B:  $24 \div 3 \div 4 \times 6$
- C:  $24 \div 6 \times 3 \div 4$
- D:  $24 \div 4 \times 6 \div 3$

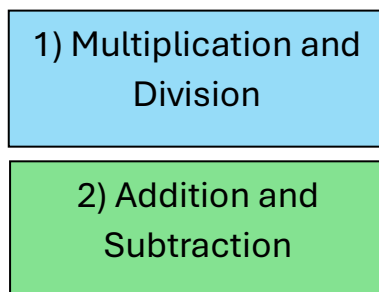
### Answer

A, B and D would be equivalent.

C would not be because we have changed the operation. Instead of  $\times 6$  it now says  $\div 6$

### Mixing the Addition/Subtraction and Multiplication/Division Groups

Now we will look what happens when you have operations from each of these groups.



Multiplication/division come before Addition/subtraction

We can think of  $+$  and  $-$  as being separators between the groups of multiplications and divisions.

### Example 4

Calculate

1)  $4 + 3 \times 2$

We have two operations,  $+$  and  $\times$

We do the multiplication first:  $3 \times 2 = 6$

Then do the addition:  $4 + 6 = 10$

2)  $2 \times 5 - 3 \times 3$

We do the two multiplications first:  $2 \times 5 = 10$

$$3 \times 3 = 9$$

Then do the subtraction:  $10 - 9 = 1$

3)  $10 + 12 \div 6 - 3$

Do the division first:  $12 \div 6 = 2$

Then we are left with:  $10 + 2 - 3$

We can either  $+2$  first, or  $-3$  first:  $10 + 2 = 12$

$$12 - 3 = 9$$

$$4) 3 + 2 \times 5 - 8 \div 2$$

Do the multiplication and division first:  $2 \times 5 = 10$

$$8 \div 2 = 4$$

Then we have:

$$3 + 10 - 4$$

We can either +10 first or -4 first:

$$3 + 10 = 13$$

$$13 - 4 = 9$$

### Your go

Calculate:

1)  $4 + 7 \times 8$

2)  $4 \times 5 + 2 \times 6$

3)  $12 \div 6 \times 2 + 5$

4)  $30 - 15 \div 3$

5)  $7 + 5 \times 2 - 6 \div 3$

### Answers

1) 60

2) 32

3) 9

4) 25

5) 15