

4109 Sets, Relations and Functions

Symbols and formulas to know

Symbols for sets:

Intersection: \cap

Union: \cup

Difference: \setminus

Complement: A' (the prime of a set)

Element of a set: \in

Set of Real numbers: \mathbb{R}

Infinity: ∞

Interval Notation: []

Set-builder Notation: $\{x \in \mathbb{R} \mid \}$

Relations: $\{(x, y) \in \mathbb{R} \times \mathbb{R} \mid \}$

Inequalities:

$<$ less than

\leq less than and equal to

$>$ greater than

\geq greater than and equal to

* When multiplying or dividing by a negative number, the inequality sign changes direction.

Formulas:

Domain: x -values

Range: y -values

Equation of a line: $y = mx + b$

Slope of a line: $m = \frac{y_2 - y_1}{x_2 - x_1}$

Vertex Formula: $\frac{-b}{2a}, \frac{-\Delta}{4a}$

Equations of the parabola:

$f(x) = a(x - h)^2 + k$ (standard form)

$f(x) = a(x - z_1)(x - z_2)$

Theory on sets

A set is a collection of objects or group of people with common characteristics.

Type of music (**set**)



Rock, rap, country, jazz

(**Subsets** or elements belonging to the set of music)

In math, we look at the set of real numbers \mathbb{R} (includes fractions and decimals).

Graphing on a number line (x-values only)

- Once you have graphed the 4 set operations on a number line, you will have to give your answer in **interval notation**, and in **set-builder notation**.

Interval notation:

⇒ Use square brackets []

⇒ When the brackets are facing the number, the number is included in the solution set
[0, 4]

⇒ When the brackets are facing away from the number, the number is not included in the solution set

]0, 4]

Set-builder notation:

⇒ Use curly brackets { }

⇒ Use inequality signs

⇒ The answer should always start with $\{x \in \mathbb{R} \mid \}$

Included or not included:

⇒ On a number line, when the number is **included**, you will draw a closed circle •

⇒ On a number line, when the number is **not included**, you will draw an open circle ○

The 4 operations on sets

Set Operation #1: Intersection \cap

The numbers that are in common to both sets.

Find $A \cap B$ (*numbers only*)

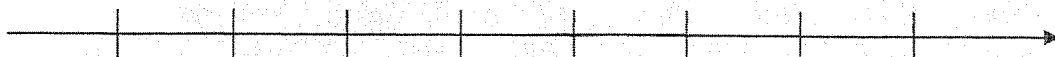
If $A = \{2, 4, 6, 8, 10, 12\}$ and $B = \{3, 4, 5, 6, 7, 8\}$

● + ● = ● included

● + ○ = ○ not included

$A = \{x \in \mathbb{R} \mid x < 4\}$ $B = \{x \in \mathbb{R} \mid x \geq 1\}$

Find $A \cap B$ (*graphing*)



Interval notation: _____

Set-builder notation: _____

Set Operation #2: Union \cup

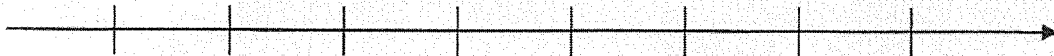
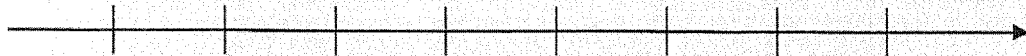
The combination of the two sets.

Find $A \cup B$ (*numbers only*)

If $A = \{2, 4, 8\}$ and $B = \{2, 4, 10, 14\}$

$A =]-1, 2]$ $B = \{x \in \mathbb{R} \mid 1 \leq x \leq 5\}$

Find $A \cup B$ (*graphing*)



Interval notation: _____

Set-builder notation: _____

Set Operation # 3: Difference of two sets

The difference of two sets is the set of elements in one set minus the set of elements in the other set.

The symbol for difference is \setminus . $A \setminus B$ is read as "A minus B"

Find $A \setminus B$ (*numbers only*)

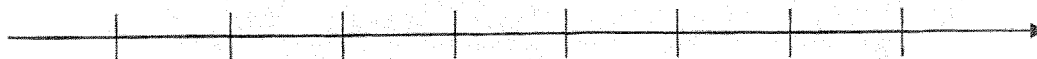
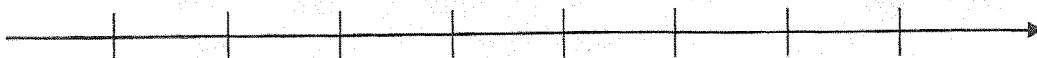
If $A = \{2, 3, 4, 6, 7\}$ and $B = \{3, 4, 5, 8, 9\}$

● - ● = ○ not included ($4 - 4 = 0$)

● - ○ = ● included ($4 - 0 = 4$)

$A =]-\infty, -1]$ $B = \{x \in \mathbb{R} \mid -3 \leq x \leq 2\}$

Find $A \setminus B$ (*graphing*)



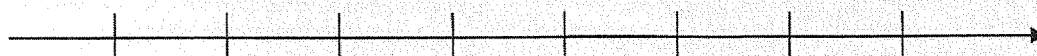
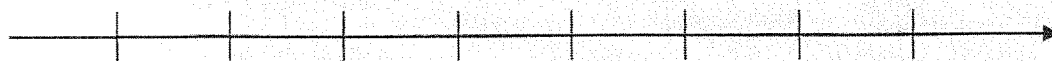
Interval notation: _____

Set-builder notation: _____

$$C = \{x \in \mathbb{R} \mid 1 \leq x < 5\}$$

$$D = [2, 4]$$

Find $C \setminus D$ (*graphing*)



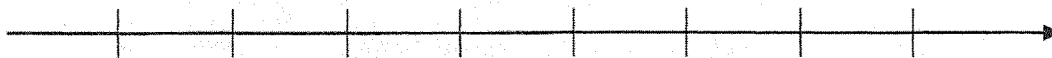
Interval notation: _____

Set-builder notation: _____

Set Operation # 4: Complement of a set

The complement of set A is written as A' (read as A prime). It is the 'opposite' of what is already in the set.

$A = \{x \in \mathbb{R} \mid x > 2\}$ Find A'



Interval notation: _____

Set-builder notation: _____

$C = [2, 5[$ Find C'



Interval notation: _____

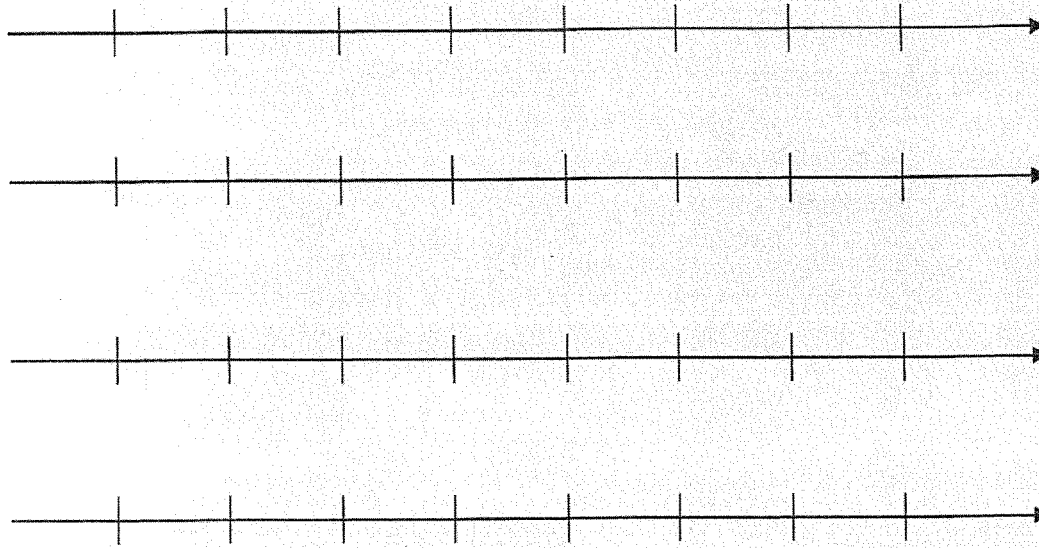
Set-builder notation: _____

Combinations

1) Find $(A \cap B)'$

$$A = \{x \in \mathbb{R} \mid 1 < x \leq 5\}$$

$$B = [2, 6[$$



Interval notation: _____

Set-builder notation: _____

2) Find $(A \cap B) \cup C$

$A = [-3, 3[$



$C = \{x \in \mathbb{R} \mid x \geq -1\}$



Interval notation: _____

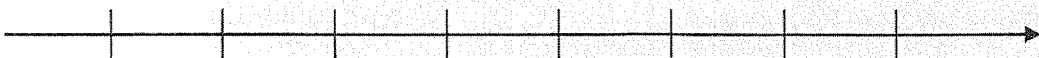
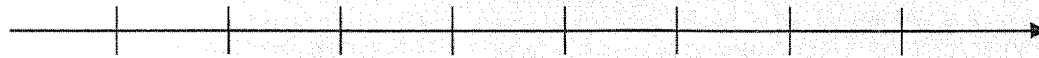
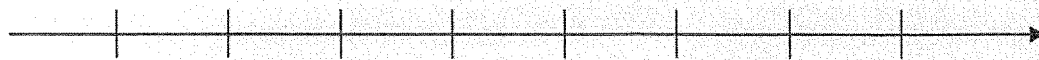
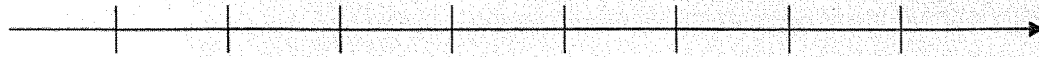
Set-builder notation: _____

Work Assignment

1. Intervals


a) Given the intervals $A = [-3, 3[$ $B = [0, \infty$ and $C =$ 

Perform the following set operations: $(A \cap B) \cup C$

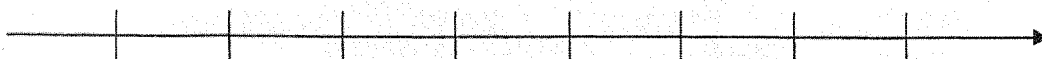
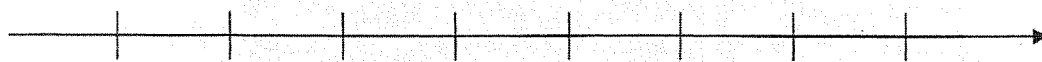
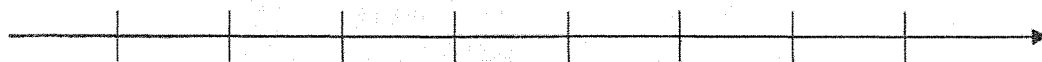


Interval notation: _____

Set-builder notation: _____

b) Given the intervals $A = -\infty, -3]$ $B = [-4, \infty$ and $C =$ 

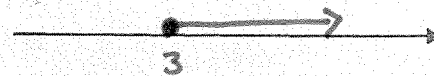
Perform the following set operations: $(A \setminus B) \cap C$



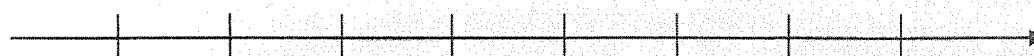
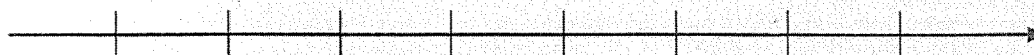
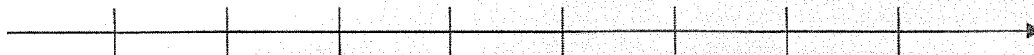
Interval notation: _____

Set-builder notation: _____

c) Given the intervals $A =]-1, 4]$, $B = [-3, 5]$ and $C =$




Perform the following set operations: $(A \cup C)' \setminus B$

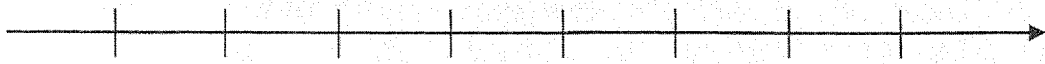
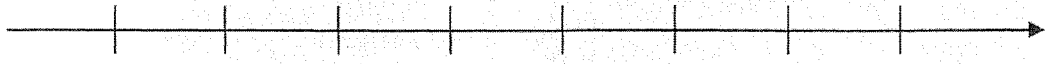


Interval notation: _____

Set-builder notation: _____


d) Given the intervals $A = -\infty, 1]$ $B = [1, \infty$ and $C =$ 

Perform the following set operations: $(A \cap C) \cup B$

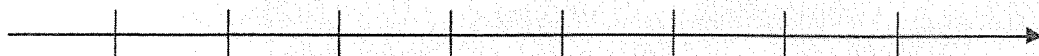
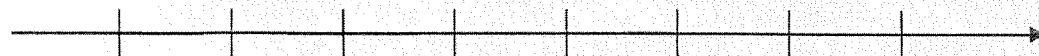
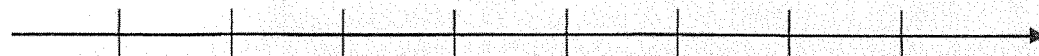


Interval notation: _____

Set-builder notation: _____

e) Given the intervals $A =] - 3, 1]$ $B = [0, \infty$ and $C =$ 

Perform the following set operations: $(A \cap B) \setminus C$



Interval notation: _____

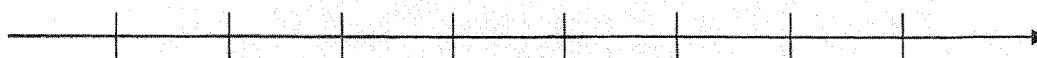
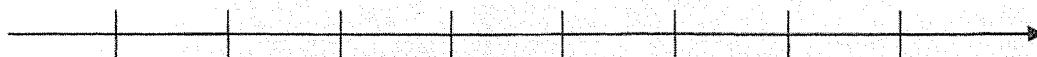
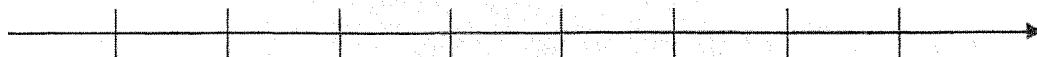
Set-builder notation: _____

2. Set-builder notation

a) Given the following sets:

$$A = \{x \in \mathbb{R} \mid x < 5\} \quad B = \{x \in \mathbb{R} \mid 3 < x < 6\}$$

Perform the following set operations: $B \setminus A$



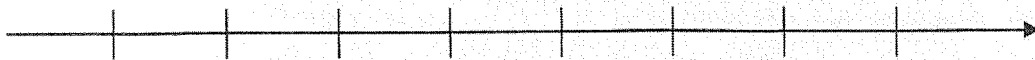
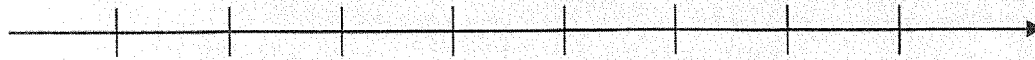
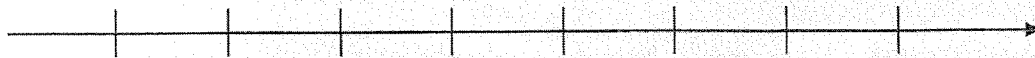
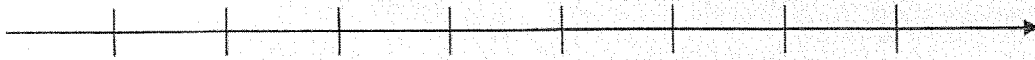
Interval notation: _____

Set-builder notation: _____

b) Given the following sets:

$$A = \{x \in \mathbb{R} \mid x \geq 2\} \quad B = \{x \in \mathbb{R} \mid -2 \leq x < 4\}$$

Perform the following set operations: $A \cup B'$



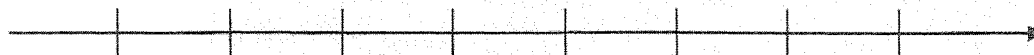
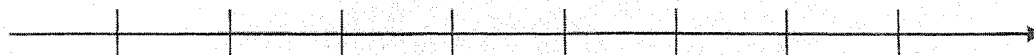
Interval notation: _____

Set-builder notation: _____

c) Given the following sets:

$$B = \{x \in \mathbb{R} \mid -1 \leq x \leq 4\} \quad C = \{x \in \mathbb{R} \mid x \geq 4\}$$

Perform the following set operations: $C' \cap B$



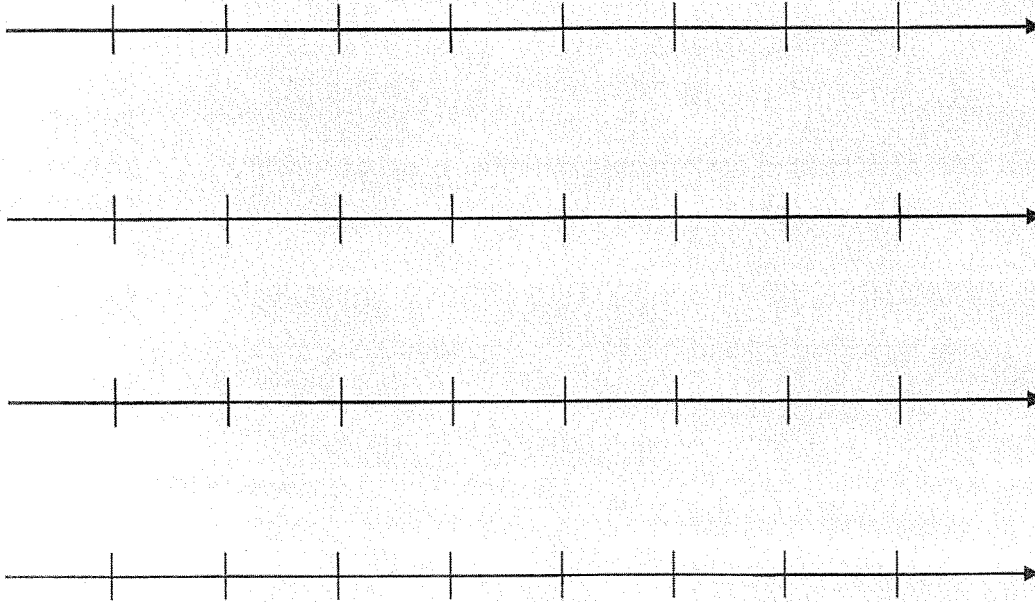
Interval notation: _____

Set-builder notation: _____

d) Given the following sets:

$$B = \{x \in \mathbb{R} \mid -2 \leq x < 3\} \quad C = \{x \in \mathbb{R} \mid x < 1\}$$

Perform the following set operations: $C \setminus B$



Interval notation: _____

Set-builder notation: _____

e) Given the following sets:

$$A = \{x \in \mathbb{R} \mid x < 3\} \quad B = \{x \in \mathbb{R} \mid -1 \leq x \leq 2\}$$

Perform the following set operations: $B \cup A'$



Interval notation: _____

Set-builder notation: _____

SETS

ANSWER KEY

The 4 operations on sets

Set Operation #1: Intersection \cap

The numbers that are in common to both sets.

Find $A \cap B$ (*numbers only*)

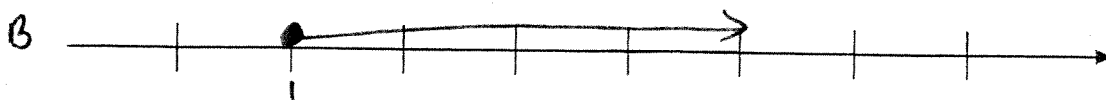
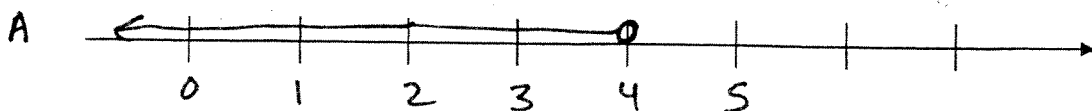
If $A = \{2, 4, 6, 8, 10, 12\}$ and $B = \{3, 4, 5, 6, 7, 8\}$

• + • = • included

• + ○ = ○ not included

$A = \{x \in \mathbb{R} \mid x < 4\}$ $B = \{x \in \mathbb{R} \mid x \geq 1\}$

Find $A \cap B$ (*graphing*)



Interval notation: $[1, 4[$

Set-builder notation: $\{x \in \mathbb{R} \mid 1 \leq x < 4\}$

Set Operation #2: Union \cup

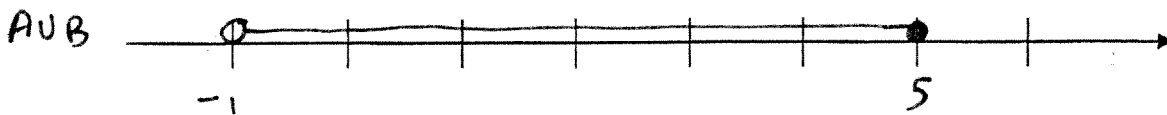
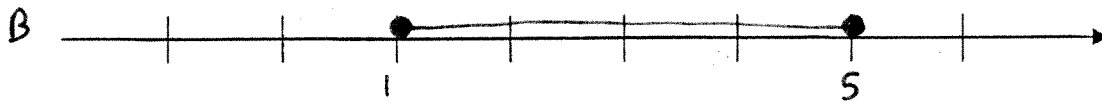
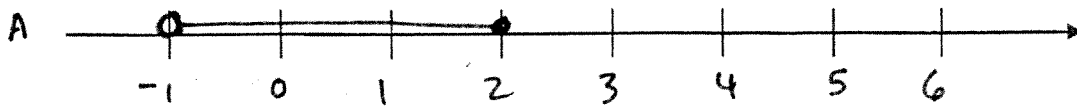
The combination of the two sets.

Find $A \cup B$ (*numbers only*)

If $A = \{2, 4, 8\}$ and $B = \{2, 4, 10, 14\}$

$A =]-1, 2]$ $B = \{x \in \mathbb{R} \mid 1 \leq x \leq 5\}$

Find $A \cup B$ (*graphing*)



Interval notation: $] -1, 5]$

Set-builder notation: $\{ x \in \mathbb{R} \mid -1 < x \leq 5 \}$

Set Operation # 3: Difference of two sets

The difference of two sets is the set of elements in one set minus the set of elements in the other set.

The symbol for difference is: \setminus $A \setminus B$ is read as "A minus B"

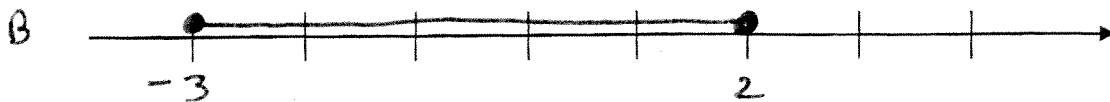
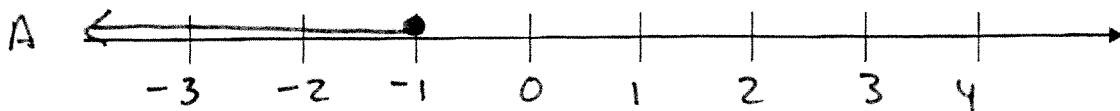
Find $A \setminus B$ (*numbers only*)

If $A = \{2, 3, 4, 6, 7\}$ and $B = \{3, 4, 5, 8, 9\}$

- - • = \circ not included ($4 - 4 = 0$)
- - \circ = • included ($4 - 0 = 4$)

$A =]-\infty, -1]$ $B = \{x \in \mathbb{R} \mid -3 \leq x \leq 2\}$

Find $A \setminus B$ (*graphing*)



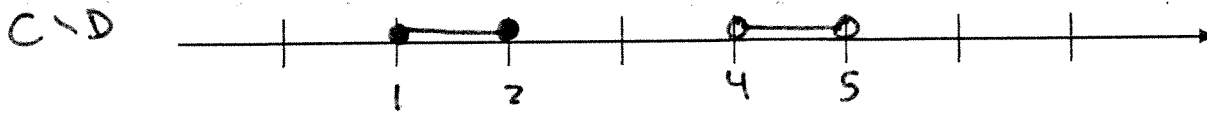
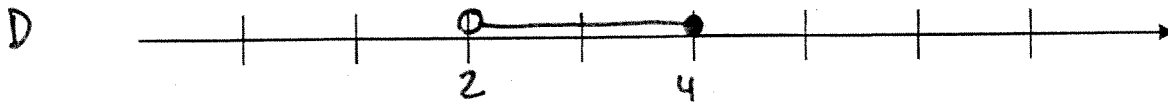
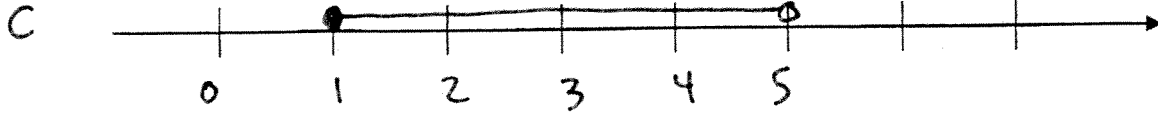
Interval notation: $-\infty, -3 [$

Set-builder notation: $\{x \in \mathbb{R} \mid x < -3\}$

$$C = \{x \in \mathbb{R} \mid 1 \leq x < 5\}$$

$$D = [2, 4]$$

Find $C \setminus D$ (graphing)



Interval notation: $[1, 2] \cup]4, 5[$

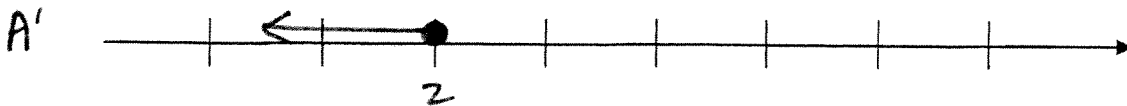
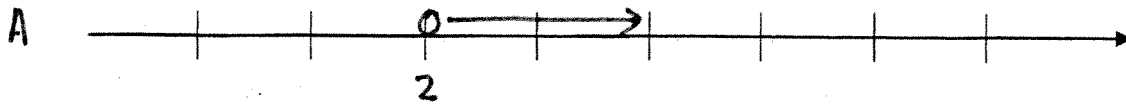
Set-builder notation: $\{x \in \mathbb{R} \mid 1 \leq x \leq 2 \vee 4 < x < 5\}$

↑
"OR"

Set Operation # 4: Complement of a set

The complement of set A is written as A' (read as A prime). It is the 'opposite' of what is already in the set.

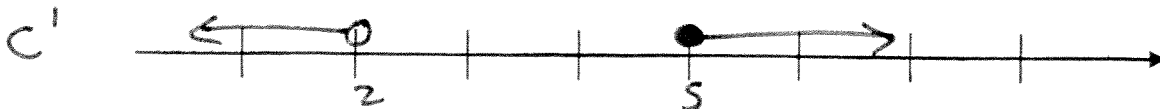
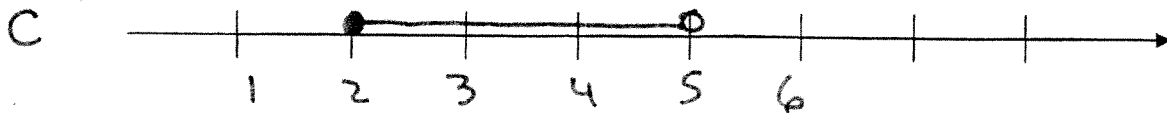
$A = \{x \in \mathbb{R} \mid x > 2\}$ Find A'



Interval notation: $-\infty, 2]$

Set-builder notation: $\{x \in \mathbb{R} \mid x \leq 2\}$

$C = [2, 5[$ Find C'



Interval notation: $-\infty, 2[\cup [5, \infty$

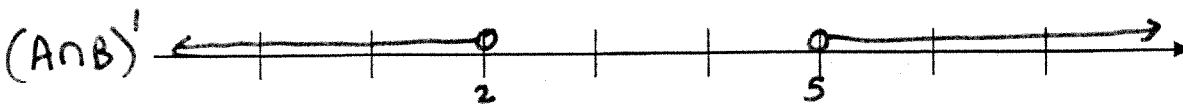
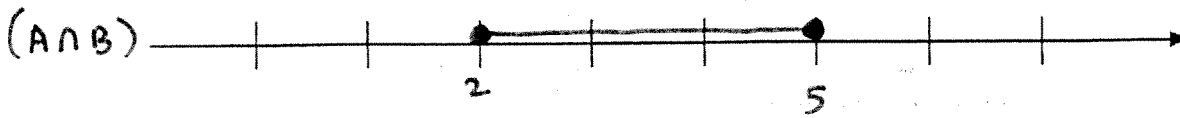
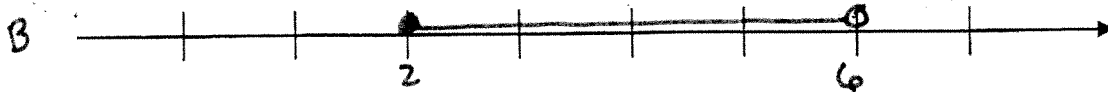
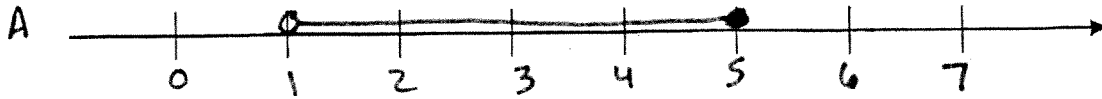
Set-builder notation: $\{x \in \mathbb{R} \mid x < 2 \vee x \geq 5\}$

Combinations

1) Find $(A \cap B)'$

$$A = \{x \in \mathbb{R} \mid 1 < x \leq 5\}$$

$$B = [2, 6[$$



Interval notation: $-\infty, 2[\cup]5, \infty$

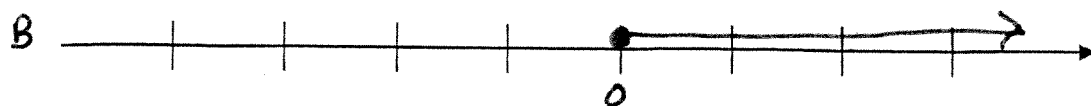
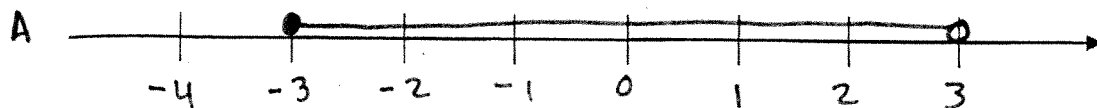
Set-builder notation: $\{x \in \mathbb{R} \mid x < 2 \vee x > 5\}$

2) Find $(A \cap B) \cup C$

$A = [-3, 3[$



$C = \{x \in \mathbb{R} \mid x \geq -1\}$



Interval notation: $[-1, \infty$

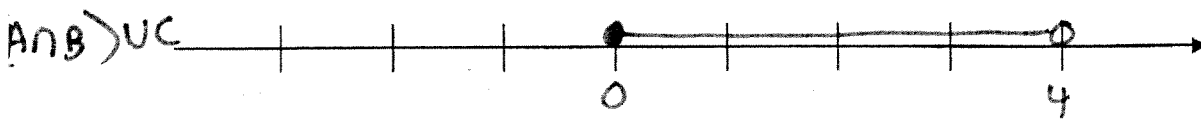
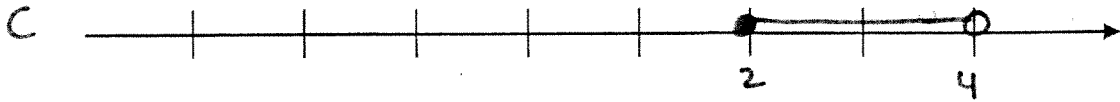
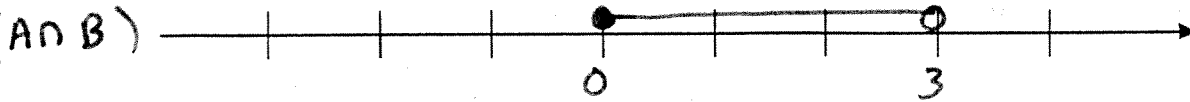
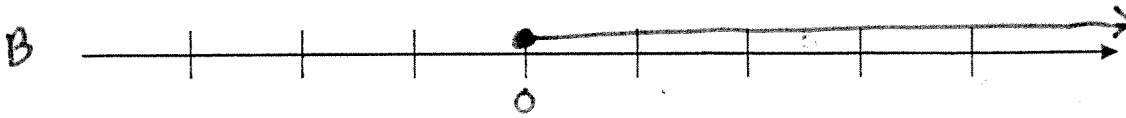
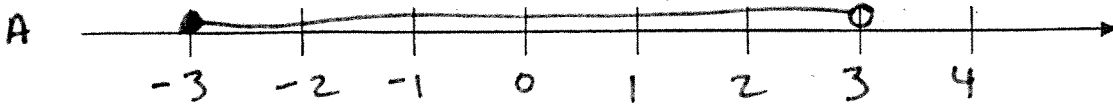
Set-builder notation: $\{x \in \mathbb{R} \mid x \geq -1\}$

Work Assignment

1. Intervals

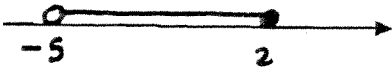
a) Given the intervals $A = [-3, 3[$ $B = [0, \infty$ and $C = \text{---} \begin{array}{c} \bullet \text{---} \bullet \\ 2 \quad 4 \end{array} \text{---}$

Perform the following set operations: $(A \cap B) \cup C$

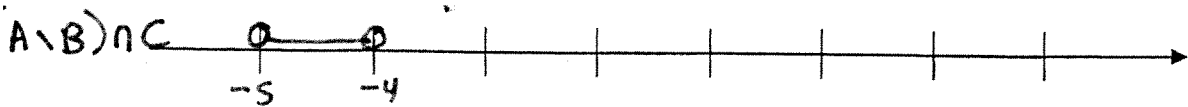
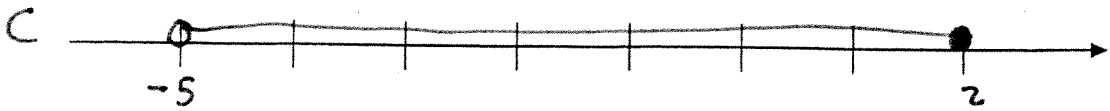
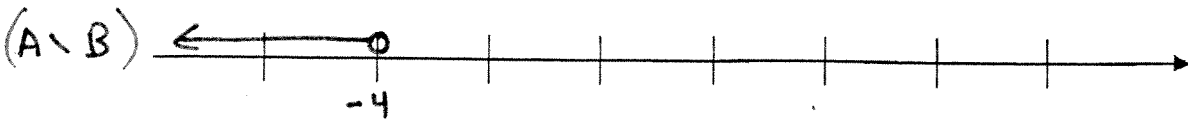
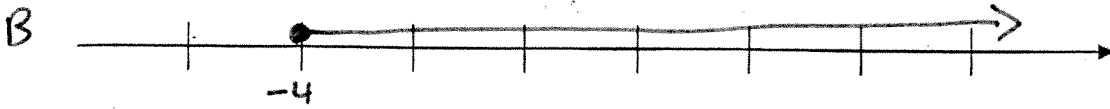
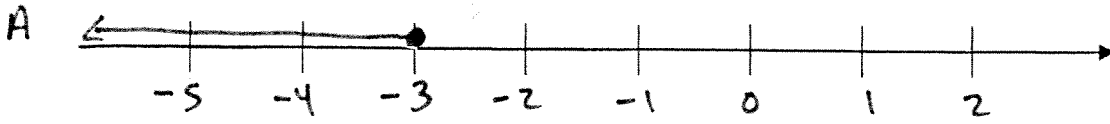


Interval notation: $[0, 4[$

Set-builder notation: $\{x \in \mathbb{R} \mid 0 \leq x < 4\}$

b) Given the intervals $A = -\infty, -3]$ $B = [-4, \infty$ and $C =$ 

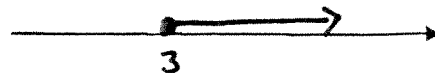
Perform the following set operations: $(A \setminus B) \cap C$



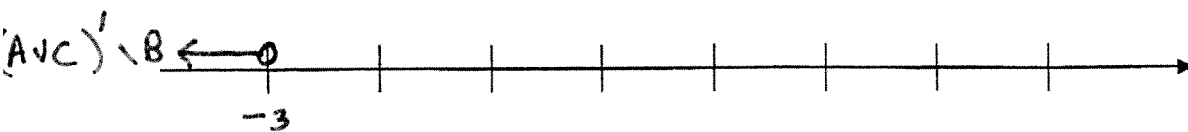
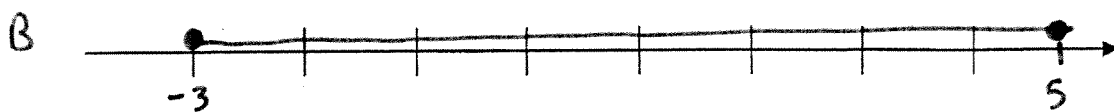
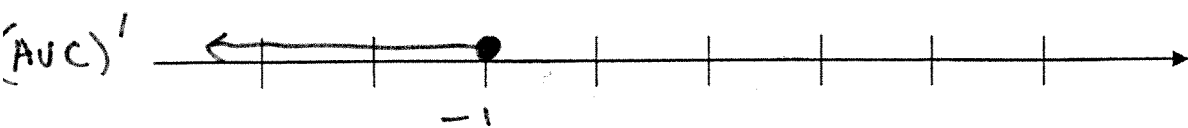
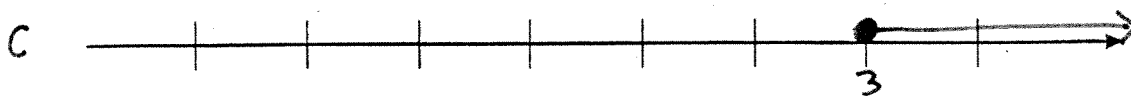
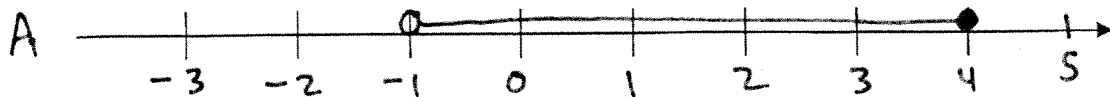
Interval notation: $] -5, -4 [$

Set-builder notation: $\{x \in \mathbb{R} \mid -5 < x < -4\}$

c) Given the intervals $A =]-1, 4]$, $B = [-3, 5]$ and $C =$

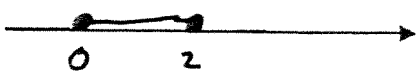


Perform the following set operations: $(A \cup C)' \setminus B$

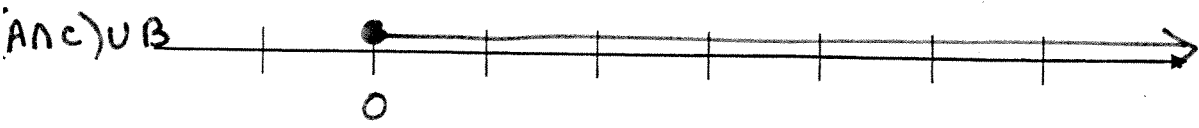
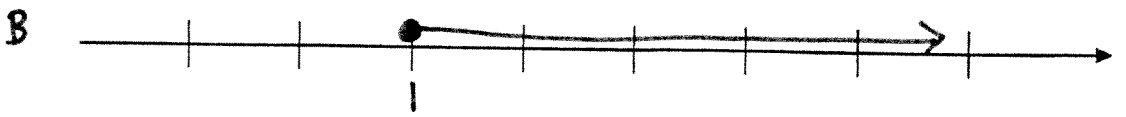
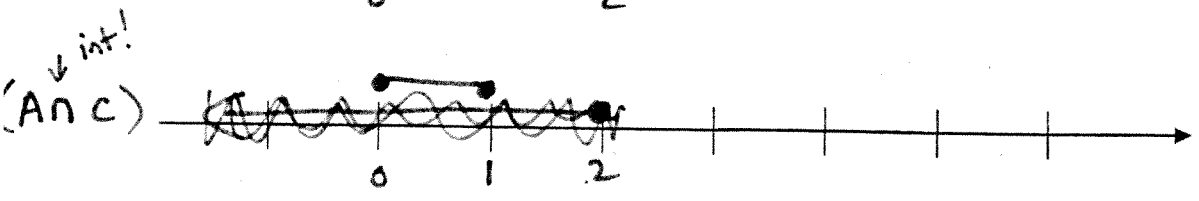
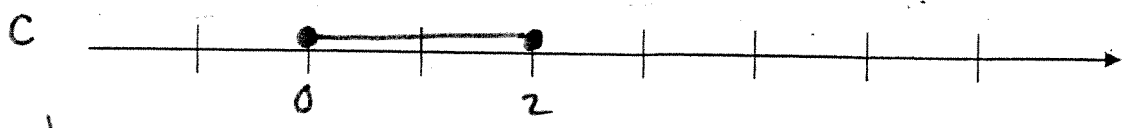
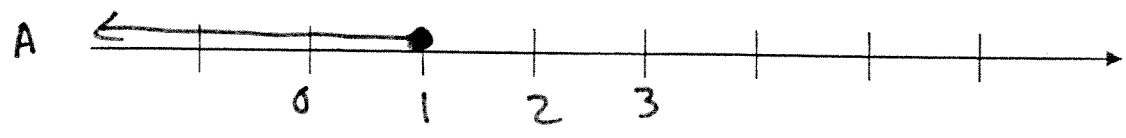


Interval notation: $-\infty, -3 [$

Set-builder notation: $\{x \in \mathbb{R} \mid x < -3\}$

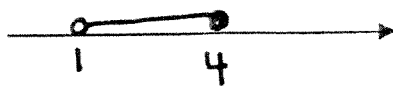
d) Given the intervals $A = -\infty, 1]$ $B = [1, \infty$ and $C =$ 

Perform the following set operations: $(A \cap C) \cup B$

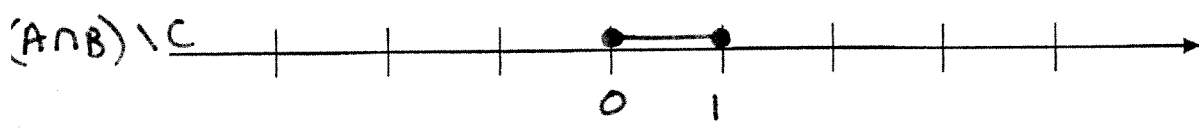
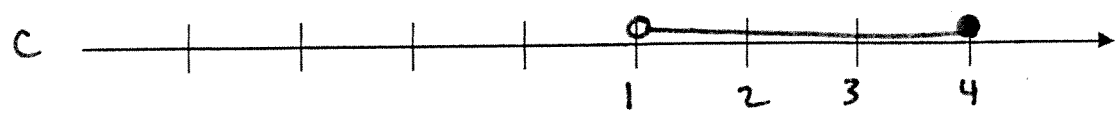
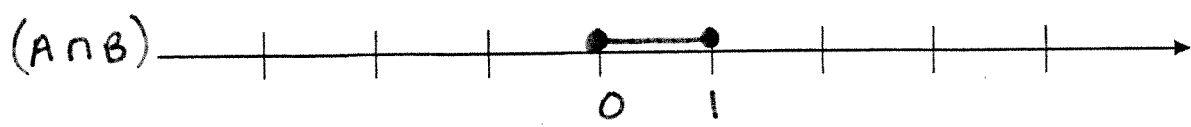
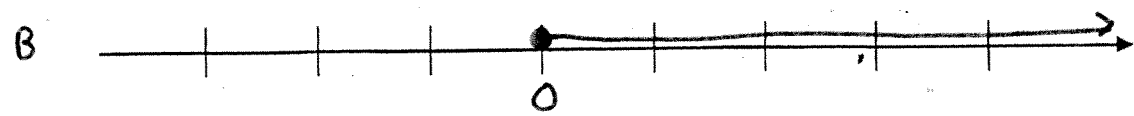
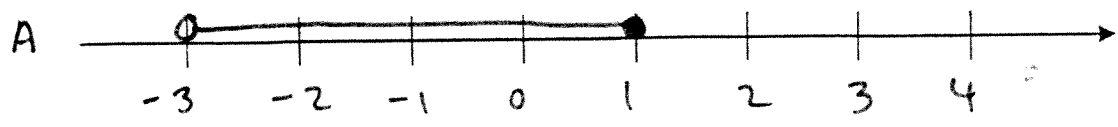


Interval notation: $[0, \infty$

Set-builder notation: $\{x \in \mathbb{R} \mid x \geq 0\}$

e) Given the intervals $A =]-3, 1]$ $B = [0, \infty$ and $C =$ 

Perform the following set operations: $(A \cap B) \setminus C$



Interval notation: $[0, 1]$

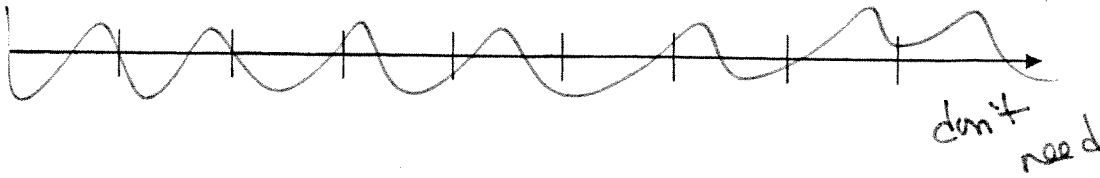
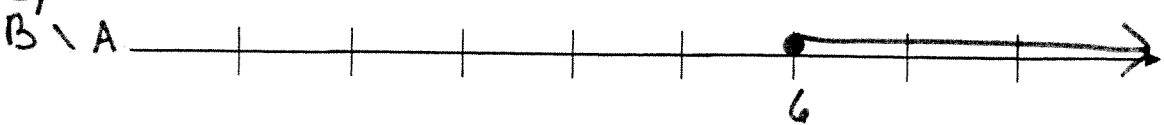
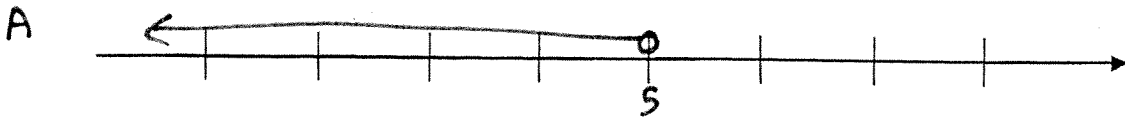
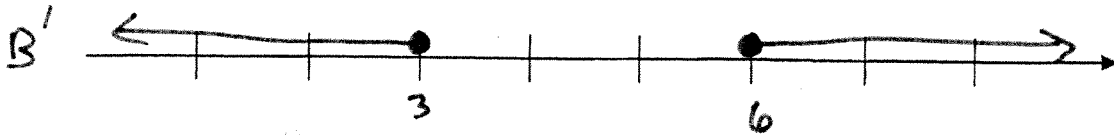
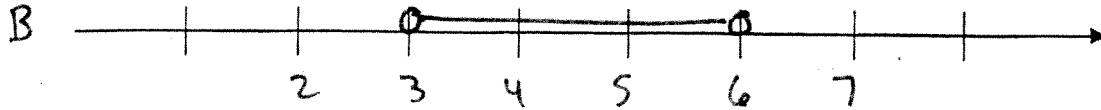
Set-builder notation: $\{x \in \mathbb{R} \mid 0 \leq x \leq 1\}$

2. Set-builder notation

a) Given the following sets:

$$A = \{x \in \mathbb{R} \mid x < 5\} \quad B = \{x \in \mathbb{R} \mid 3 < x < 6\}$$

Perform the following set operations: $B \setminus A$



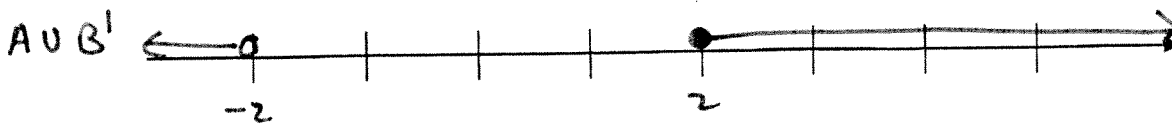
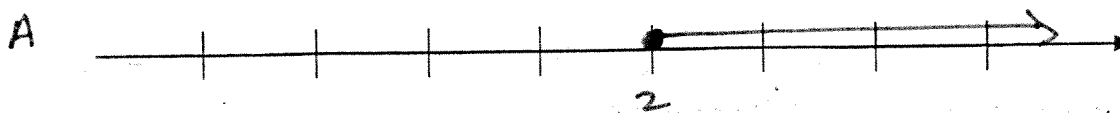
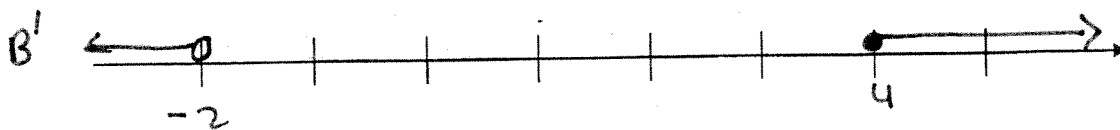
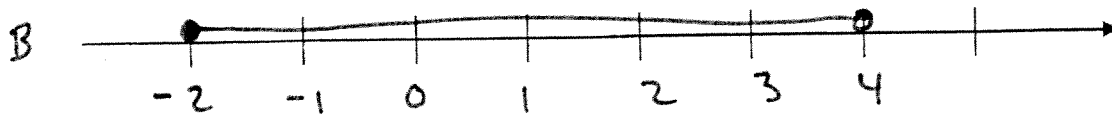
Interval notation: $[6, \infty$

Set-builder notation: $\{x \in \mathbb{R} \mid x \geq 6\}$

b) Given the following sets:

$$A = \{x \in \mathbb{R} \mid x \geq 2\} \quad B = \{x \in \mathbb{R} \mid -2 \leq x < 4\}$$

Perform the following set operations: $A \cup B'$



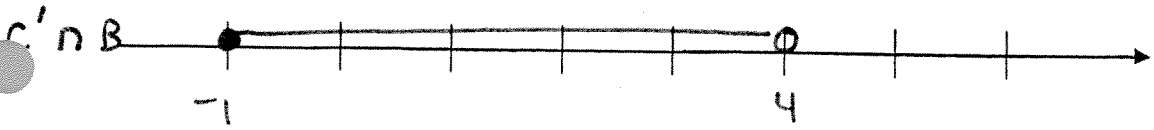
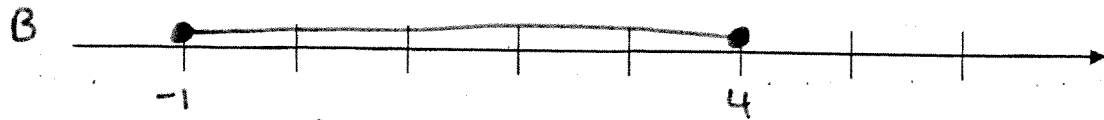
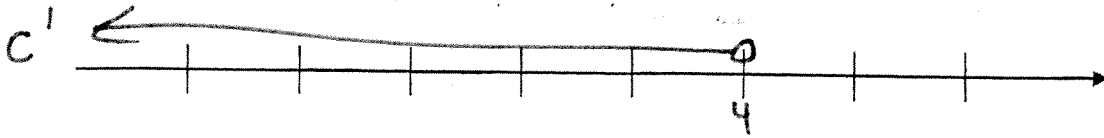
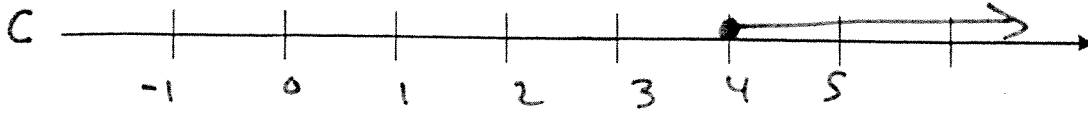
Interval notation: $-\infty, -2[\cup [2, \infty$

Set-builder notation: $\{x \in \mathbb{R} \mid x < -2 \vee x \geq 2\}$

c) Given the following sets:

$$B = \{x \in \mathbb{R} \mid -1 \leq x \leq 4\} \quad C = \{x \in \mathbb{R} \mid x \geq 4\}$$

Perform the following set operations: $C' \cap B$



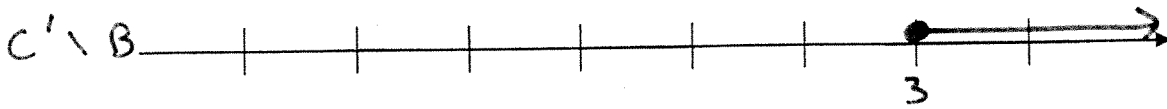
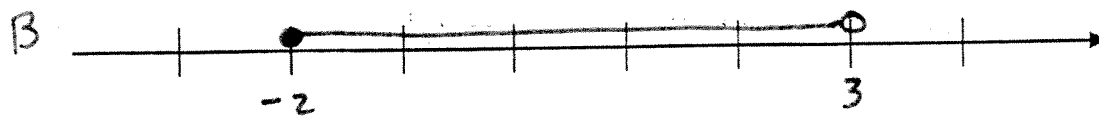
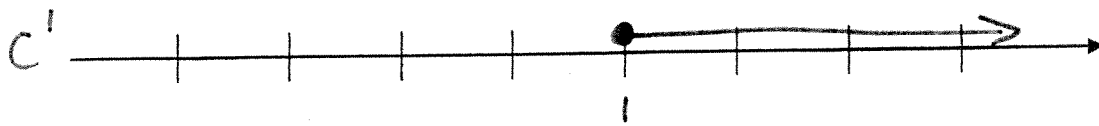
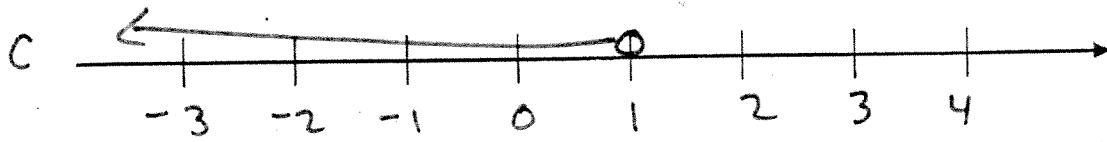
Interval notation: $[-1, 4[$

Set-builder notation: $\{x \in \mathbb{R} \mid -1 \leq x < 4\}$

d) Given the following sets:

$$B = \{x \in \mathbb{R} \mid -2 \leq x < 3\} \quad C = \{x \in \mathbb{R} \mid x < 1\}$$

Perform the following set operations: $C \setminus B$



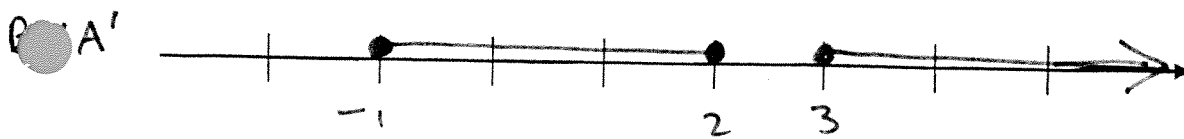
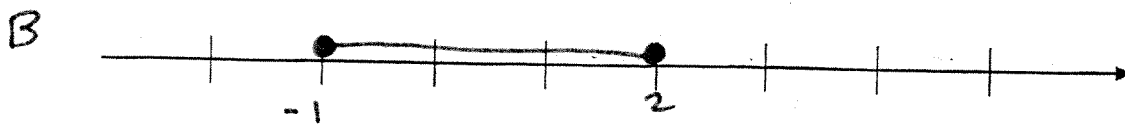
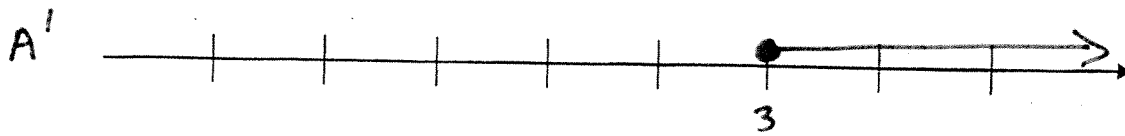
Interval notation: $[3, \infty$

Set-builder notation: $\{x \in \mathbb{R} \mid x \geq 3\}$

e) Given the following sets:

$$A = \{x \in \mathbb{R} \mid x < 3\} \quad B = \{x \in \mathbb{R} \mid -1 \leq x \leq 2\}$$

Perform the following set operations: $B \cup A'$



Interval notation: $[-1, 2] \cup [3, \infty$

Set-builder notation: $\{x \in \mathbb{R} \mid -1 \leq x \leq 2 \vee x \geq 3\}$

SETS

ANSWER KEY