

Mathematical Set Theory

1. Draw Venn diagrams that represent the following set relations.

U	U	U
$X \subseteq Y$	X and Y intersect	X and Y are disjoint

2. Draw Venn diagrams that represent the following set relations. Be sure to shade in the appropriate area.

U	U	U
$X \cup Y$	$X \cap Y$	X^c

U	U
$X \setminus Y$	$X \oplus Y$

3. Provide a name and description (and/or example) for the special sets, set relations and set operations represented by the following symbols:

Symbol Name	Description (and/or example)
U	_____
\emptyset	_____
$=$	_____
\neq	_____
\in	_____
\notin	_____
\subset	_____
\supset	_____
\cup	_____
\cap	_____
\setminus	_____
\oplus	_____

4. Consider the following pitch-class sets:

Pitch-class set	Description ¹	Pitch-class set	Description
$H = (C, E, G)$	C: I	$N = (C, D, E, F, G, A, B)$	Major on C
$I = (G, B, D)$	G: V	$O = (E, F, G, A, B, C, D)$	Phrygian on E
$J = (G, B, D, F)$	G^7 : V^7	$P = (F\sharp, G\sharp, A\sharp, C\sharp, D\sharp)$	Major pentatonic on $F\sharp$
$K = (F, A, C)$	F: IV	$Q = (C, D, E, F\sharp, G\sharp, A\sharp)$	Whole-tone on C
$L = (B, D, F)$	B° : vii°	$R = (D\flat, E\flat, F, G, A, B)$	Whole-tone on $D\flat$
$M = (D, F, A, C)$	Dm^7 : ii^7	$S = (C, C\sharp, D\sharp, E, F\sharp, G, A, B\flat)$	Octatonic (half-whole) on C
		$T = (D, F, A\flat, B)$	Fully-diminished triad on B
		$V = (C, E\flat, F\sharp, A)$	Fully-diminished triad on $F\sharp$
		$W = (C\sharp, E, G, B\flat)$	Fully-diminished triad on $C\sharp$
		$X = (C, E, G\sharp)$	Augmented triad on C
		$Y = (C\sharp, D, D\sharp, F, F\sharp, G, A, A\sharp, B)$	Messiaen-9

Keeping in mind that the *aggregate* may be listed (using sharps-only notation) as $U = (C, C\sharp, D, D\sharp, F, F\sharp, G, A, A\sharp, B)$, and that *enharmonic equivalence* applies in post-tonal theory, find the result of the following set operations. Express your answer using letter name notation (4.1-4.11) and set variable names (4.12-4.22), as requested. Then indicate whether the relations in 4.23-4.43 are true or false.

Use Letter name notation	Use set variable names (H - Y), U or \emptyset
4.1 $H \cup I =$ _____	4.12 $N \cup P =$ _____
4.2 $H \cup K =$ _____	4.13 $Q \cup R =$ _____
4.3 $I \cup J =$ _____	4.14 $N^c =$ _____
4.4 $I \cap J =$ _____	4.15 $P^c =$ _____
4.5 $H \cap I =$ _____	4.16 $Q^c =$ _____
4.6 $H \cap K =$ _____	4.17 $R^c =$ _____
4.7 $H \cap L =$ _____	4.18 $S^c =$ _____
4.8 $H \cap M =$ _____	4.19 $T^c =$ _____
4.9 $H \cap K =$ _____	4.20 $V \cup W =$ _____
4.10 $J \cap L =$ _____	4.21 $X^c =$ _____
4.11 $Q \cap R =$ _____	4.22 $Y^c =$ _____
True or False	
4.23 $F\sharp \in P$ _____	4.33 $T \cup S = U$ _____
4.24 $C \in L$ _____	4.34 $T \cup V \cup W = U$ _____
4.25 $C \in M$ _____	4.35 $X \cup Y = \emptyset$ _____
4.26 $C \notin H$ _____	4.36 $Q \cap R = \emptyset$ _____
4.27 $G \notin H$ _____	4.37 $N \cup P = U$ _____
4.28 $N = O$ _____	4.38 $V \cup W = S$ _____
4.29 $N \neq O$ _____	4.39 $I \subseteq J$ _____
4.30 $Q = R$ _____	4.40 $N \supseteq H$ _____
4.31 $N^c = P$ _____	4.41 $X \subseteq Q$ _____
4.32 $S^c = V$ _____	4.42 $X \subseteq Q$ _____
4.32 $N = P$ _____	4.42 $X \subseteq X$ _____

¹ Lead-sheet symbol and key with roman numeral.