If there are any symbols or terminology you do not recognize then please let us know.

(1) Give the truth table for the following propositions

Expression	**Meaning**
$a \wedge b$	a and b
$a \vee b$	a or b
$a \oplus b$	a xor b
$\neg a$ (or $\bar{a}$)	not a
$a \implies b$	a implies b, or: if a then b
$a \iff b$	a and b are equivalent, or: "a if and only if b"

It is usual to apply these "bit-wise" to the bits of integers, e.g. $\texttt{0011} \oplus \texttt{0101} = \texttt{0110}$.

(2) Recall that $\mathbb{N} = \{1, 2, 3, \ldots\}$ is the set of **natural numbers**, and $\mathbb{Z} = \{\ldots, -3, -2, -1, 0, 1, 2, 3, \ldots\}$ is the set of **integers**.

Consider the following set definitions

- $A = \{a \in \{1, 2, 3, 4\} \mid (a < 2) \vee (a > 3)\}$
- $B = \{a \in \mathbb{N} \mid a < 9\}$
- $C = \{a \in \mathbb{N} \mid a > 2 \wedge a < 7\}$
- $D = \{i \in \mathbb{Z} \mid i^2 \leq 9\}$

a) Give an explicit enumeration for each set, i.e. write down the elements in the form $\{x_1, x_2, \ldots\}$.

b) What is the cardinality of each set?

c) Which of these sets are subsets of at least one other set?

(3) If the set A is $\{1, 3, 4\}$ and the set B is $\{3, 5\}$, write down:

Expression	**Meaning**
$A \cup B$	union of A and B
$A \cap B$	intersection of A and B
$A - B$	A minus B
$A \times B$	Cartesian product of A and B: set of all possible pairs (a, b) where $a \in A$ and $b \in B$
2^B (or $\mathcal{P}(B)$)	power set of B: set of all subsets of B

(4) Draw the (undirected) graph $G = (V, E)$, where

$$\begin{aligned} V &= \{1, 2, 3, 4, 5\} \\ E &= \{(1, 2), (1, 4), (2, 3), (2, 4), (3, 5), (1, 5)\} \end{aligned}$$

a) Is the graph connected?

b) What about the graph $G' = (V', E')$, where $V' = \{1, 2, 3, 4\}$ and $E' = \{(1, 3), (2, 4)\}$?

(5) Draw the graph $G = (V, E)$, where $V = \{1, \ldots, 5\}$ and

$$E = \{(a, b) \mid a, b \in V \wedge (a < b < a + 3)\}.$$

(6) Express the following expressions using O-notation

- $x + 5$
- $2784x + 132 \times 1074$
- $x + x \log^2 x + 35$
- 2016
- $x^{578} + 4685 + 2^x$
- $2016^x + x^x + x!$
- $543x + x^3 + 13$
- $x^2 + x(\log x)^2 + 35$
- $x^{86754} + x!$