



**Basic Logic Review**  
**Class Exercise 1A**

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## Rules

- If you believe that you know a correct answer, please raise your hand
- I will select *one or more* students (independently whether an answer given by the first student is correct or incorrect)
- Please, identify yourself by first name and give an answer
- **Correct answer = 1 bonus point**

### Problem 1

List all 2-input logic gates that you can recall

### Problem 2

How many 2-input logic functions can be theoretically defined (whether they make sense or not)?

### Problem 3

List all 1-input logic gates.

### Problem 4

What is a minimum set of gates that can be used to implement all logic functions?

**Problem 5**

List four ways of expressing logic functions.

**Problem 6**

How many select inputs does an 8-to-1 MUX have?

How many select inputs does an n-to-1 MUX have?

**Problem 7**

How many outputs does a decoder with two data inputs have?

How many outputs does a decoder with n data inputs have?

**Problem 8**

Show how to implement a decoder that recognizes the following 4 ranges of a 16-bit address A, and generates the corresponding enable signals  $e_0, e_1, e_2, e_3$ :

For A in:	Assert
C000-CFFF:	$e_0$
D000-DFFF:	$e_1$
E000-EFFF:	$e_2$
F000-FFFF:	$e_3$

**Problem 9**

How many inputs does an encoder with two data outputs have?

How many inputs does an encoder with n data outputs have?

**Problem 10**

What is a difference between encoder and priority encoder?

**Problem 11**

Show how to implement a 4-to-2 MSB Priority Encoder using multiplexers and a minimum number of logic gates

**Problem 12**

What is the width of an output of a 4x4 unsigned multiplier?

What is the width of an output of a 4x4 signed multiplier?

What is the width of an output of a NxN unsigned multiplier?

**Problem 13**

What is the width of an output of a 4x8 unsigned multiplier?

What is the width of an output of a 4x8 signed multiplier?

What is the width of an output of a NxM unsigned multiplier?

**Problem 14**

Give an example of binary inputs to an unsigned 4x4 multiplier and a signed 4x4 multiplier that produce different results.

**Problem 15**

Explain using simple diagrams (based on medium-scale logic components) how to efficiently perform the following operations in hardware using combinational logic only

A.  $C = A \lll 3$

B.  $C = A \lll B$ ,

where A, B, and C are 8-bit variables.

**Problem 16**

What is a size of a memory with a 4-bit address input and an 8-bit data output?

What is a size of a memory with an m-bit address input and an n-bit data output?

**Problem 17**

Show how to implement a **3x3 squarer**,  
implementing equation  $y = x^2$ ,  
using **ROM** (diagram + contents of ROM).

**Problem 18**

What is a function of a tri-state buffer?