Name: ……………………………………………….. ( ) Class: ……… Date: …………………..

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| **2.1** | **Computer Architecture** | **Logic Circuits and Truth Tables** |

1. Draw the truth tables for the following Boolean statements.

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| **Truth Table** |
| 1. Q = A OR (NOT B) |
| 1. Q = (A AND B) OR C |
| 1. Q = NOT (A OR B) AND C |

1. Examine the car seat belt alarm system below.

*Ignition*

Ignition Off = 0

Ignition On = 1

*Engine*

Engine Off = 0

Engine On = 1

*Seat Belt*

Not Fastened = 0

Fastened = 1

*Buzzer*

Buzzer Off = 0

Buzzer On = 1

The engine will be switched on if ignition is on and seat belt is fastened.

The buzzer will sound if ignition is on but seat belt is not fastened.

Complete the truth table below for all possible combinations if inputs.

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| --- | --- | --- | --- |
| **Ignition** | **Seat Belt** | **Engine** | **Buzzer** |
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1. A homeowner wants to implement an air-conditioning system with automatic features in his home. If the room thermometer detects that the temperature is above 30 degrees Celsius and somebody is at home, the air-conditioner will be switched on. If the room thermometer detects that the weather is equal to or below 30 degrees Celsius or the situation is such that no one is at home, the air-conditioner will be switched off.

The homeowner has a temperature sensor that is able to detect if the temperature is above 30 degrees Celsius and a motion sensor that is able to detect if anyone is at home.

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| **Input** | **Binary** | **Condition** |
| Temperature sensor | 0 | Equal or below 30 degrees Celsius |
| 1 | Above 30 degrees Celsius |
| Motion Sensor | 0 | No motion detected |
| 1 | Motion detected |

Given these devices, identify the relevant input(s) and output(s), then draw the corresponding a) truth table and b) logic circuit diagram.

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| **Truth Table** |
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| **Logic Circuit Diagram** |
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1. The logic circuit diagram below represents the ideal conditions for a student to complete his/her homework for the day. It has 3 inputs and 1 output:

Input A: Whether student understood the lessons in class  
(0 = did not understand, 1 = understood)

Input B: Whether student consulted a teacher about the lessons  
(0 = did not consult, 1 = consulted)

Input D: Whether student is on MC for the day  
(0 = not on MC, 1 = on MC)

Output Z: Whether the student could complete his/her homework for the day  
(0 = did not complete, 1 = completed)

1. A student is able to complete his/her homework if he/she was not on MC for the day and either understood the lessons in class or consulted a teacher about the lessons. Complete the circuit diagram below by drawing a suitable logic gate.

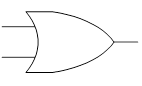


A: Understood lessons in class

B: Consulted teacher on lessons

C: on MC

Z: Could complete homework



1. Construct the corresponding truth table.

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| **Truth Table** |
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For questions 5 to 7, you may use a logic circuit simulator to test out the logic circuit design.

1. A house has two doors, a front door and a side door. The owner of the house wants to install a burglar alarm system that will work on both doors. The keypad is switched on when the owner is not at home. It is switched off when he is at home.

Input A: Whether the front door is open (0 = closed, 1 = open)

Input B: Whether the side door is open (0 = closed, 1 = open)

Input D: Whether the keypad is switched on (0 = off, 1 = on)

Output Z: Whether the alarm is ringing (0 = silent, 1 = ringing)

1. Fill in each box with a suitable logic gate to complete the logic circuit diagram.

Z: Alarm

D: Keypad

A: Front door

B: Side door

C:

1. Write down the corresponding Boolean statement.

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| **Boolean Statement** |
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1. Evaluate the Boolean statement by means of its truth table.

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| **Truth Table** |
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1. For the logic problem below, write down the a) truth table, b) logic circuit diagram and c) Boolean statement. In this problem, a device has 3 inputs and 1 output:

Input T: Whether the device’s thermostat is on (0 = off, 1 = on)

Input C: Whether the device’s cover is on (0 = off, 1 = on)

Input M: Whether the device’s timer is on (0 = off, 1 = on)

Output Z: Whether the device’s light indicator is on (0 = off, 1 = on)

When the device is functioning correctly, its light indicator should turn on if:

**either** its thermostat (T) is off and its cover (C) is off,

**or** its timer (M) is on and its cover (C) is off.

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| **Truth Table** |
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| **Logic Circuit Diagram** |
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| **Boolean Statement** |
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1. A buzzer in a chemical plant sounds when certain conditions occur.

The output, Q, of a logic circuit that drives the buzzer must have a value of 1 only if:

**either** heat detector (A) high and pressure valve (B) low and water level (C) high

**or** heat detector (A) low and pressure valve (B) high and water level (C) low

The inputs to the system are:

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| **Input** | **Binary** | **Condition** |
| A | 0 | Heat detector low |
| 1 | Heat detector high |
| B | 0 | Pressure valve low |
| 1 | Pressure valve high |
| C | 0 | Water level low |
| 1 | Water level high |

1. Write down the Boolean statement.

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| **Boolean Statement** |
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1. Draw a logic circuit for the system.

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| **Logic Circuit Diagram** |
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1. Write down the truth table.

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| **Truth Table** |
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