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UNIT 3

DIGITAL SYSTEMS & LOGIC DESIGN

Multiple Choice Questions

with Answers & Detailed Explanations

Class 9 • Computer Science & Entrepreneurship

85 MCQs • Answers Highlighted ✓

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Section 1

Basics of Digital Systems (Analog vs. Digital)

10 Questions

1

Which of the following best describes an analog signal?

A It has only two discrete values (0 and 1)

B It changes smoothly and continuously over time ✓

C It is only used in computers

D It represents binary data

✓ **Correct Answer: B) It changes smoothly and continuously over time**

Explanation: Analog signals are continuous in nature and can take an infinite number of values within a given range. Examples include sound waves and temperature, which change smoothly rather than in distinct steps.

2

Which device converts analog signals into digital signals?

A DAC

B **ADC**



C Microphone

D Speaker

✓ **Correct Answer: B) ADC**

Explanation: An Analog-to-Digital Converter (ADC) takes continuous analog input (like a human voice) and converts it into discrete digital data (0s and 1s) that computers can process.

3

What is the primary reason digital signals are preferred over analog signals for long-distance transmission?

A They are cheaper to produce

B **They are less affected by noise and signal degradation** ✓

C They can carry infinite values

D They require no conversion

✓ **Correct Answer: B) They are less affected by noise and signal degradation**

Explanation: Because digital signals only consist of two distinct states (on or off, 0 or 1), minor fluctuations caused by noise do not corrupt the data as easily as they do in continuous analog signals. This makes digital transmission much more reliable.

4

In the context of digital logic, what do the values 0 and 1 typically represent?

A Low and high voltage levels, respectively ✓

B High and low voltage levels, respectively

C Analog and continuous signals

D True and False states for analog circuits

✓ **Correct Answer: A) Low and high voltage levels, respectively**

Explanation: In physical digital circuits, 0 represents a low voltage level (e.g., 0V), and 1 represents a high voltage level (e.g., 5V). These physical voltage levels map to the logical concepts of False and True.

5

Which of the following is an example of a digital device?

A A traditional mercury thermometer

B A vinyl record player

C A modern smartphone



D A voice microphone

✓ **Correct Answer: C) A modern smartphone**

Explanation: Smartphones process all information as binary data (0s and 1s). Thermometers, record players, and microphones produce or operate on continuous analog signals, whereas smartphones rely entirely on digital logic.

6 What does DAC stand for?**A Digital to Analog Converter** ✓**B** Data to Analog Connection**C** Digital Access Controller**D** Dual Analog Circuit**✓ Correct Answer: A) Digital to Analog Converter**

Explanation: DAC stands for Digital to Analog Converter. It performs the reverse operation of an ADC, taking digital data (like an MP3 file) and converting it into analog signals (like sound waves for a speaker).

7

When you speak into a microphone, what type of signal is initially produced?

A Digital signal

B Binary signal

C **Analog signal**



D Discrete signal

✓ **Correct Answer: C) Analog signal**

Explanation: Sound waves are physical, continuous vibrations. When a microphone captures these sound waves, it translates them into continuous electrical voltage variations, which are analog signals.

8

Which of the following is NOT a characteristic of a digital signal?

- A Discrete values
- B Infinite possible values** ✓
- C Represented as 0s and 1s
- D Used in computing systems

✓ **Correct Answer: B) Infinite possible values**

Explanation: Digital signals have a finite set of possible values, typically just two (0 and 1). Analog signals are the ones that possess infinite possible values within a given range.

9

What is the role of a speaker in a digital audio system?

- A** It acts as an ADC
- B** It acts as a DAC ✓
- C** It stores digital data
- D** It amplifies analog signals only

✓ **Correct Answer: B) It acts as a DAC**

Explanation: A speaker receives digital audio data and converts it back into physical sound waves (analog) for human ears. This conversion process from digital to analog is the function of a DAC.

10

Which of the following is an example of an analog signal?

A Binary data in computers

B **Human voice**



C Digital clock display

D Data on a USB drive

✓ **Correct Answer: B) Human voice**

Explanation: Human voice is a natural continuous wave. The other options (binary data, digital clock, USB data) are all discrete, digital representations.

Section 2

Boolean Algebra and Logic Gates

20 Questions

11**Who is credited with inventing Boolean algebra?****A** Alan Turing**B** **George Boole** ✓**C** Charles Babbage**D** John von Neumann✓ **Correct Answer: B) George Boole**

Explanation: George Boole, an English mathematician born in 1815, invented Boolean algebra, which laid the foundation for modern digital computer logic.

12

What is the primary use of Boolean algebra in computer science?

A To perform arithmetic calculations

B To analyze and design digital circuits ✓

C To convert analog to digital signals

D To store data in memory

✓ **Correct Answer: B) To analyze and design digital circuits**

Explanation: Boolean algebra uses variables that can only be True (1) or False (0). This mathematical framework is essential for analyzing, simplifying, and designing the logic circuits that make up computer processors.

13

What is the output of the AND operation when both inputs are 1?

A 0

B 1



C Undefined

D Depends on the voltage

✓ **Correct Answer: B) 1**

Explanation: The AND gate (represented by '.') outputs a 1 (True) only when all of its inputs are 1. If either input is 0, the output is 0.

14

Which logical operation is represented by the symbol '+' in Boolean algebra?

A AND

B NOT

C OR



D XOR

✓ **Correct Answer: C) OR**

Explanation: The '+' symbol in Boolean algebra stands for the OR operation. It outputs a 1 if at least one of the inputs is 1.

15

In Boolean algebra, what is the result of $1 + 1$?

A 2

B 10

C 0

D 1



✓ **Correct Answer: D) 1**

Explanation: Boolean algebra is logic, not arithmetic. The '+' symbol means "OR." If one thing is True OR another thing is True, the combined result is simply True (1). It does not add up numerically to 2.

16

Which logic gate outputs the opposite (inverse) of its input?

A AND

B OR

C NOT



D NAND

✓ **Correct Answer: C) NOT**

Explanation: The NOT gate, also known as an inverter, takes a single input and flips it. If the input is 1 (True), the output is 0 (False), and vice versa.

17

What is the Boolean expression for the AND operation?

A $F = A + B$

B $F = A . B$ ✓

C $F = A \oplus B$

D $F = A'$

✓ **Correct Answer: B) $F = A . B$**

Explanation: The AND operation is typically written as $A . B$ or simply AB . The '+' is for OR, ' $\oplus$ ' is for XOR, and ' A' ' represents NOT A.

18 What does a truth table represent?

A The physical layout of a circuit

B All possible input combinations and their corresponding outputs ✓

C The voltage levels of a digital circuit

D The conversion process of an ADC

✓ **Correct Answer: B) All possible input combinations and their corresponding outputs**

Explanation: A truth table is a fundamental tool in digital logic that exhaustively lists every possible combination of inputs (0s and 1s) and defines what the output will be for each combination.

19

How many possible input combinations are there for a Boolean function with 3 variables (A, B, C)?

A 3

B 6

C 8



D 9

✓ **Correct Answer: C) 8**

Explanation: The number of possible combinations for binary variables is 2 raised to the power of the number of variables. For 3 variables, $2^3 = 8$ combinations (000, 001, 010, 011, 100, 101, 110, 111).

20

Which logic gate is known as the "inverter"?

A AND

B OR

C NOT



D XOR

✓ **Correct Answer: C) NOT**

Explanation: Because the NOT gate simply inverts the input signal (0 becomes 1, and 1 becomes 0), it is commonly referred to as an inverter.

21

What is the output of a NAND gate when both inputs are 1?

A 1

B 0



C Undefined

D High impedance

✓ **Correct Answer: B) 0**

Explanation: A NAND gate is an AND gate followed by a NOT gate. Since an AND gate with inputs 1 and 1 outputs 1, the subsequent NOT gate inverts it to 0.

22 The XOR gate outputs true (1) only when:

- A** Both inputs are true
- B** Both inputs are false
- C** Exactly one input is true ✓
- D** At least one input is true

✓ **Correct Answer: C) Exactly one input is true**

Explanation: XOR stands for "Exclusive OR." It outputs 1 only if the inputs are different (one is 1 and the other is 0). If both inputs are the same (both 0 or both 1), it outputs 0.

23

Which gate is equivalent to an AND gate followed by a NOT gate?

A OR

B NOR

C **NAND**



D XOR

✓ **Correct Answer: C) NAND**

Explanation: The name NAND is a contraction of "NOT AND." It represents the inverse of the AND operation.

24

In Boolean algebra, what is the complement of A?

A $A + 1$

B $A . 1$

C $\neg A$ or A'



D $A + A$

✓ **Correct Answer: C) $\neg A$ or A'**

Explanation: The complement of a variable is its opposite value. It is represented by a bar over the variable ($\bar{A}$) or a prime symbol (A').

25

Which of the following is NOT a basic logic gate?

A AND

B OR

C NOT

D XNOR



✓ **Correct Answer: D) XNOR**

Explanation: The three fundamental or basic logic gates are AND, OR, and NOT. NAND, NOR, XOR, and XNOR are considered derived or universal gates, built by combining the basic three.

26

According to the OR operation, the output is 0 only when:

- A Both inputs are 1
- B At least one input is 1
- C Both inputs are 0** ✓
- D One input is 1 and the other is 0

✓ **Correct Answer: C) Both inputs are 0**

Explanation: The OR gate outputs 1 if any input is 1. The only way to get a 0 output is if every single input is 0.

27

If $A = 1$ and $B = 0$, what is the value of $F = A . B$?

A 1

B 0



C 10

D Undefined

✓ **Correct Answer: B) 0**

Explanation: The '.' represents the AND operation. Since one of the inputs (B) is 0, the output of the AND gate must be 0, regardless of the state of input A.

28

If $A = 1$ and $B = 0$, what is the value of $F = A + B$?

A 1



B 0

C 10

D Undefined

✓ **Correct Answer: A) 1**

Explanation: The '+' represents the OR operation. Since at least one input (A) is 1, the output of the OR gate will be 1.

29

What is the primary function of an Arithmetic Logic Unit (ALU) in a CPU?

A To convert analog signals

B To perform Boolean logic and arithmetic operations ✓

C To store permanent data

D To manage power supply

✓ **Correct Answer: B) To perform Boolean logic and arithmetic operations**

Explanation: The ALU is a digital circuit within the CPU that carries out arithmetic (like addition and subtraction) and bitwise logic operations (like AND, OR, NOT) using Boolean functions.

30

Which logic gate is used to check if two inputs are equal?

A AND

B XOR ✓

C OR

D NAND

✓ **Correct Answer: B) XOR**

Explanation: The XOR gate outputs 1 when inputs are different. By inverting an XOR (using XNOR), you get a 1 when inputs are identical. Therefore, XOR is the fundamental basis for equality checking circuits.

Section 3

Boolean Simplification and Laws

10 Questions

31 Which Boolean law states that $A + 0 = A$?**A** Null Law**B** Identity Law **C** Idempotent Law**D** Complement Law**✓ Correct Answer: B) Identity Law**

Explanation: The Identity Law states that ORing a variable with 0 (the identity element for OR) leaves the variable unchanged. Similarly, ANDing with 1 ($A \cdot 1 = A$) is also the Identity Law.

32

Which law is represented by the equation $A + A = A$?

A Identity Law

B Null Law

C Idempotent Law



D Absorption Law

✓ **Correct Answer: C) Idempotent Law**

Explanation: The Idempotent Law states that combining a variable with itself using AND or OR results in the variable itself. $A + A = A$ and $A \cdot A = A$.

33

What is the result of $A + 1$ according to Boolean algebra?

A A

B **1**



C 0

D $1 + A$

✓ **Correct Answer: B) 1**

Explanation: This is the Null Law. In Boolean logic, if you OR anything with True (1), the result is always True (1), regardless of the value of A.

34

Which theorem states that $(A + B)' = A' \cdot B'$?

A De Morgan's Theorem ✓

B Distributive Law

C Associative Law

D Absorption Law

✓ **Correct Answer: A) De Morgan's Theorem**

Explanation: De Morgan's Theorem provides a way to simplify the complement of a complex expression. It states that the complement of a sum (OR) is the product (AND) of the complements.

35

According to the Complement Law, what is $A \cdot A'$?

A 1

B A

C 0



D A'

✓ **Correct Answer: C) 0**

Explanation: The Complement Law states that a variable ANDed with its complement always equals 0 (False), because a statement cannot be both true and false at the same time. Conversely, $A + A' = 1$.

36

What is the simplified form of the expression $A + A \cdot B$?

A A 

B B

C $A + B$

D $A \cdot B$

✓ **Correct Answer: A) A**

Explanation: This is the Absorption Law ($A + A \cdot B = A$). Conceptually, if A is true, the whole expression is true. If A is false, both A and $A \cdot B$ are false. Therefore, B has no impact on the outcome; the result depends entirely on A .

37

Which law allows you to write $A \cdot (B + C) = (A \cdot B) + (A \cdot C)$?

A Commutative Law

B Associative Law

C **Distributive Law**



D Identity Law

✓ **Correct Answer: C) Distributive Law**

Explanation: The Distributive Law allows you to multiply (AND) a variable across a sum (OR), exactly like distributing numbers in standard algebra.

38 Which law states that $A \cdot B = B \cdot A$?

A Associative Law

B Commutative Law ✓

C Distributive Law

D Absorption Law

✓ **Correct Answer: B) Commutative Law**

Explanation: The Commutative Law dictates that the order of the operands does not matter for the AND and OR operations.

39 The Double Negation Law states that:

A $A + A' = 1$

B $(A')' = A$ ✓

C $A \cdot A' = 0$

D $A + 0 = A$

✓ **Correct Answer: B) $(A')' = A$**

Explanation: The Double Negation Law states that inverting a variable twice returns it to its original state. If you say "It is not raining is false," it means "It is raining."

40

Simplify the Boolean expression: $(A + B) \cdot (A + B')$

A **A** **B** B**C** 1**D** $A \cdot B$

✓ **Correct Answer: A) A**

Explanation: Using the Distributive Law in reverse (or standard algebraic factoring), this becomes $A + (B \cdot B')$. According to the Complement Law, $B \cdot B' = 0$. So, the expression becomes $A + 0$. According to the Identity Law, $A + 0 = A$.

Section 4

Logic Diagrams, Half-Adders, and Full-Adders

12 Questions

41

What is the primary function of a Half-Adder circuit?

A To add three binary numbers

B To add two single-bit binary numbers ✓

C To subtract two binary numbers

D To multiply two binary numbers

✓ **Correct Answer: B) To add two single-bit binary numbers**

Explanation: A half-adder is the most basic digital arithmetic circuit. It takes two single-bit inputs (A and B) and produces a Sum and a Carry output.

42

How many inputs and outputs does a Half-Adder have?

A 2 inputs, 1 output

B 2 inputs, 2 outputs ✓

C 3 inputs, 2 outputs

D 3 inputs, 1 output

✓ **Correct Answer: B) 2 inputs, 2 outputs**

Explanation: A half-adder takes two inputs (the bits to be added) and produces two outputs: the Sum (S) and the Carry (C).

43

What is the Boolean expression for the Sum (S) output of a Half-Adder?

A $S = A \cdot B$

B $S = A + B$

C $S = A \oplus B$



D $S = A' \cdot B$

✓ **Correct Answer: C) $S = A \oplus B$**

Explanation: The sum of two single bits is 1 only when the inputs are different ($0+1=1$ or $1+0=1$). This is the exact behavior of the XOR gate.

44

What is the Boolean expression for the Carry (C) output of a Half-Adder?

A $C = A \oplus B$

B $C = A + B$

C $C = A \cdot B$ ✓

D $C = A'$

✓ **Correct Answer: C) $C = A \cdot B$**

Explanation: A carry is generated only when both inputs are 1 (1+1=10, which means sum 0, carry 1). This is the AND operation.

45

Which circuit is used to add three single-bit binary numbers?

A Half-Adder

B Full-Adder



C Multiplexer

D Decoder

✓ **Correct Answer: B) Full-Adder**

Explanation: A full-adder is designed to handle three inputs: two significant bits (A and B) and a carry-in bit (Cin) from a previous addition.

46

How many inputs does a Full-Adder have?

A 2

B 3



C 4

D 5

✓ **Correct Answer: B) 3**

Explanation: A full-adder has three inputs: A, B, and Cin (Carry In).

47

In a Full-Adder, what is the Boolean expression for the Sum (S)?

A $S = A \oplus B$

B $S = A \oplus B \oplus \text{Cin}$



C $S = (A \cdot B) + \text{Cin}$

D $S = A + B + \text{Cin}$

✓ **Correct Answer: B) $S = A \oplus B \oplus \text{Cin}$**

Explanation: The sum output of a full adder is high when an odd number of inputs are high. This cascading XOR logic ($A \text{ XOR } B \text{ XOR } \text{Cin}$) perfectly captures that behavior.

48 What does a logic diagram represent?

- A** The physical size of the circuit
- B** **The structure of a digital circuit using logic gate symbols** ✓
- C** The cost of manufacturing the circuit
- D** The power consumption of the circuit

✓ **Correct Answer: B) The structure of a digital circuit using logic gate symbols**

Explanation: Logic diagrams are schematic representations. They show how different logic gates are connected together to process the inputs and generate the required outputs.

49

In a Full-Adder, the Carry output (Cout) is 1 when:

A Exactly one input is 1

B At least two inputs are 1 ✓

C All three inputs are 0

D The sum output is 1

✓ **Correct Answer: B) At least two inputs are 1**

Explanation: A carry is generated when the sum of the inputs exceeds 1. Therefore, if two or three of the inputs (A, B, Cin) are 1, a carry-out (Cout) is generated.

50

Which gates are required to construct a Half-Adder?

A Two AND gates

B One XOR gate and one AND gate ✓

C Two OR gates

D One XOR gate and one OR gate

✓ **Correct Answer: B) One XOR gate and one AND gate**

Explanation: As derived from the Boolean expressions, the Sum requires an XOR gate ($A \oplus B$) and the Carry requires an AND gate ($A \cdot B$).

51

What is the primary advantage of using a Full-Adder over a Half-Adder?

A It is faster

B

It can accept a carry from a previous stage



C It uses fewer gates

D It only works with zeros

✓ **Correct Answer: B) It can accept a carry from a previous stage**

Explanation: The defining feature of a full-adder is its Cin (Carry In) input. This allows multiple full-adders to be chained together to add multi-bit binary numbers (like 4-bit, 8-bit, etc.).

52

In the context of adder circuits, what does the XOR operation represent conceptually?

A The carry generation

B The sum generation without considering the carry ✓

C The power supply logic

D The reset function

✓ **Correct Answer: B) The sum generation without considering the carry**

Explanation: XOR produces a high output when the inputs are odd (1+0 or 0+1). This perfectly matches the sum bit of binary addition, whereas the AND gate handles the carry bit.

Section 5

Karnaugh Maps (K-Maps) and Minterms

13 Questions

53

What is the primary purpose of a Karnaugh Map (K-Map)?

A To convert analog signals to digital

B

To graphically simplify Boolean expressions



C To build truth tables

D To design adders

✓ **Correct Answer: B) To graphically simplify Boolean expressions**

Explanation: A K-Map is a visual tool used to simplify logic functions. By arranging truth table values in a grid, it allows you to easily spot and group patterns to minimize Boolean expressions without complex algebra.

54

What is the grid size for a 3-variable K-Map?

A 2 x 2

B 2 x 4



C 4 x 4

D 4 x 8

✓ **Correct Answer: B) 2 x 4**

Explanation: The size of a K-Map depends on the number of variables. A 2-variable map is 2x2 (4 cells), a 3-variable map is 2x4 (8 cells), and a 4-variable map is 4x4 (16 cells).

55

In a K-Map, adjacent cells differ by how many bits?

A 2 bits

B 1 bit



C 3 bits

D All bits

✓ **Correct Answer: B) 1 bit**

Explanation: K-Maps are arranged using Gray code, where adjacent cells (horizontally or vertically) differ by only a single bit. This property allows for the simplification of expressions by grouping adjacent 1s.

56 What is a "minterm" in Boolean algebra?

- A** A product term where all variables appear exactly once (either true or complemented) ✓
- B** A sum term where all variables appear exactly once
- C** The minimum number of gates needed
- D** The smallest K-Map grid size

✓ **Correct Answer: A) A product term where all variables appear exactly once (either true or complemented)**

Explanation: A minterm is a standard product (AND) term that contains every variable in the function, either in its normal or complemented form. Each minterm corresponds to exactly one row in the truth table.

57

When grouping 1s in a K-Map, groups must be powers of:

A 2 (1, 2, 4, 8, etc.)



B 3 (1, 3, 9, etc.)

C 5 (1, 5, 10, etc.)

D Any number

✓ **Correct Answer: A) 2 (1, 2, 4, 8, etc.)**

Explanation: To successfully simplify a Boolean expression using a K-Map, you must group adjacent 1s in sizes that are powers of two (1, 2, 4, 8, 16, etc.). Grouping in other sizes (like 3 or 5) does not yield a simplified Boolean term.

58

How many cells does a 4-variable K-Map have?

A 4

B 8

C 16



D 32

✓ **Correct Answer: C) 16**

Explanation: A 4-variable K-Map has $2^4 = 16$ cells, arranged in a 4x4 grid, representing every possible combination of the four variables.

59

What is the main benefit of simplifying a Boolean expression using a K-Map?

A It makes the circuit more complex

B It reduces the number of gates required, making the circuit cheaper and more efficient ✓

C It converts the circuit to analog

D It changes the truth table

✓ **Correct Answer: B) It reduces the number of gates required, making the circuit cheaper and more efficient**

Explanation: Simplification via K-Maps results in fewer logic gates and connections. This translates directly to reduced manufacturing costs, lower power consumption, faster processing speed, and a more compact circuit design.

60

A K-Map grid is filled with values from which source?

- A** The circuit diagram
- B** **The truth table** ✓
- C** The voltage supply
- D** The manufacturer's datasheet

✓ **Correct Answer: B) The truth table**

Explanation: To use a K-Map, you first construct the truth table for the Boolean function. The output values (0s and 1s) from the truth table are then transferred into the corresponding cells of the K-Map.

61

What is the simplified expression if a K-Map has a group of four 1s covering the entire row where $A = 1$?

A A ✓**B** A' **C** 1 **D** B

✓ **Correct Answer: A) A**

Explanation: Grouping an entire row where $A=1$ means the output is entirely dependent on A being true. The other variables (B , C , etc.) change across the row, cancel each other out during grouping, and are eliminated, leaving just A .

62

Minterm m_3 for variables A, B, C (where $A=0$, $B=1$, $C=1$) is written as:

A $A' B C$ ✓

B $A B' C$

C $A B C'$

D $A' B' C$

✓ **Correct Answer: A) $A' B C$**

Explanation: In a minterm, if a variable is 0, it is complemented (A'), and if it is 1, it is written as is (B, C). Therefore, $A=0$, $B=1$, $C=1$ becomes $A'BC$.

63

What does a grouping of eight 1s in a 4-variable K-Map eliminate?

A One variable

B Two variables

C Three variables



D All variables

✓ **Correct Answer: C) Three variables**

Explanation: In a K-Map of n variables, a group of 2^k 1s eliminates k variables. For a 4-variable map, a group of 8 (which is 2^3) eliminates 3 variables, leaving only 1 variable in the simplified term.

64

The Gray code sequence used in K-Maps ensures that:

A

Only one bit changes between adjacent cells ✓

B The map is symmetrical

C All 1s are grouped together

D The circuit is analog

✓ **Correct Answer: A) Only one bit changes between adjacent cells**

Explanation: This is the fundamental principle of K-Map construction. Because adjacent cells differ by only one bit, grouping them allows that differing variable to be eliminated (since it appears as both 0 and 1 in the group), simplifying the logic.

65

If a Boolean function $F(A,B) = A'B + AB'$, how is this represented in a K-Map?

A Two 1s in diagonal cells

B Two 1s in adjacent cells ✓

C Four 1s in all cells

D Two 1s in the same row

✓ **Correct Answer: B) Two 1s in adjacent cells**

Explanation: $A'B$ corresponds to the cell $(A=0, B=1)$ and AB' corresponds to $(A=1, B=0)$. In a 2-variable K-Map, these two cells are horizontally or vertically adjacent, allowing them to be grouped if simplification permits (though in this case, they are an XOR function and cannot be simplified further together).

Section 6

Mixed Application and High-Yield Exam Questions

20 Questions

66

Which Boolean law is used to simplify $A + A'B$ to $A + B$?

A De Morgan's Theorem

B Distributive Law and Complement Law ✓

C Associative Law

D Identity Law

✓ **Correct Answer: B) Distributive Law and Complement Law**

Explanation: $A + A'B = (A + A')(A + B)$ [Distributive Law]. Since $A + A' = 1$ [Complement Law], the expression becomes $1 \cdot (A + B) = A + B$ [Identity Law].

67 The XOR gate is also known as a:

- A** Parity generator
- B** Inequality detector
- C** Both A and B ✓
- D** None of the above

✓ **Correct Answer: C) Both A and B**

Explanation: The XOR gate outputs 1 when inputs are unequal, making it an inequality detector. It is also used in parity checking circuits to detect errors in data transmission, acting as a parity generator.

68

What is the output of a NOR gate when both inputs are 0?

A 0

B 1



C Undefined

D High impedance

✓ **Correct Answer: B) 1**

Explanation: A NOR gate is an OR gate followed by a NOT gate. An OR gate with inputs 0 and 0 outputs 0. The NOT gate inverts this to 1.

69

Which of the following is a universal logic gate?

A AND

B OR

C **NAND**



D XOR

✓ **Correct Answer: C) NAND**

Explanation: NAND and NOR gates are called "universal gates" because any other logic gate (AND, OR, NOT, etc.) can be constructed using only NAND gates or only NOR gates.

70

In a half-adder, if $A = 1$ and $B = 1$, what are the Sum and Carry outputs respectively?

A Sum = 0, Carry = 1



B Sum = 1, Carry = 0

C Sum = 1, Carry = 1

D Sum = 0, Carry = 0

✓ **Correct Answer: A) Sum = 0, Carry = 1**

Explanation: Binary addition of $1 + 1$ equals 10 (which is 2 in decimal). The sum bit is 0, and the carry bit is 1. This aligns with $S = A \oplus B = 0$ and $C = A \cdot B = 1$.

71

Which Boolean theorem is used to convert a NAND operation to an OR operation with inverted inputs?

A De Morgan's Theorem ✓

B Commutative Law

C Idempotent Law

D Null Law

✓ **Correct Answer: A) De Morgan's Theorem**

Explanation: De Morgan's Theorem states that $(A \cdot B)' = A' + B'$. This means a NAND operation is equivalent to ORing the inverted inputs.

72

What is the primary difference between a Half-Adder and a Full-Adder?

A

Half-Adder adds 2 bits, Full-Adder adds 3 bits ✓

B

Half-Adder uses XOR, Full-Adder uses AND

C

Half-Adder has no carry output

D

Full-Adder has no sum output

✓ **Correct Answer: A) Half-Adder adds 2 bits, Full-Adder adds 3 bits**

Explanation: The defining functional difference is the number of input bits they can process. A half-adder takes two inputs (A, B); a full-adder takes three (A, B, Cin).

73 In a K-Map, overlapping groups are:

A Not allowed

B Allowed and often necessary to achieve maximum simplification ✓

C Only allowed for 2-variable maps

D Only allowed for 4-variable maps

✓ **Correct Answer: B) Allowed and often necessary to achieve maximum simplification**

Explanation: Overlapping groups is a valid and often essential strategy in K-Map simplification. It allows you to form larger groups, which eliminates more variables and results in a more simplified final Boolean expression.

74

Which logic gate is used to implement the Boolean expression $F = A'B + AB'$?

A AND

B OR

C XOR



D NAND

✓ **Correct Answer: C) XOR**

Explanation: The expression $A'B + AB'$ is the standard sum-of-products (SOP) form for the XOR operation. It yields 1 only when A and B are different.

75

Why are digital circuits generally more reliable than analog circuits?

A They are immune to all types of noise

B They operate on discrete voltage levels, making them less susceptible to minor voltage fluctuations ✓

C They use less power

D They are smaller in size

✓ **Correct Answer: B) They operate on discrete voltage levels, making them less susceptible to minor voltage fluctuations**

Explanation: Because digital circuits only care about two distinct states (0 and 1, or low and high voltage), slight variations or noise in the voltage level don't change the logical state, unlike analog circuits where any voltage variation changes the signal.

76

What is the output of an AND gate if one input is 0 and the other is 1?

A 1

B 0



C Undefined

D High

✓ **Correct Answer: B) 0**

Explanation: The AND gate requires all inputs to be 1 to output a 1. Since one input is 0, the output is forced to 0.

77 The Boolean expression $A + A'$ is equal to:

A 0

B 1 ✓

C A

D A'

✓ **Correct Answer: B) 1**

Explanation: According to the Complement Law, a variable ORed with its complement always equals 1 (True). Either A is true, or A is false; one of them must be true, so the result is always true.

78

Which of the following is NOT a valid Boolean algebra rule?

A $A + 1 = 1$

B $A \cdot 0 = 0$

C $A + A = 2A$



D $A \cdot A = A$

✓ **Correct Answer: C) $A + A = 2A$**

Explanation: Boolean algebra does not use coefficients like standard algebra. $A + A$ simply equals A (Idempotent Law). There is no concept of " $2A$ " in Boolean logic.

79

In a Full-Adder, what is the Boolean expression for Carry Out (Cout)?

A $C_{out} = A \cdot B$

B $C_{out} = (A \cdot B) + (C_{in} \cdot (A \oplus B))$ ✓

C $C_{out} = A + B + C_{in}$

D $C_{out} = A \oplus B \oplus C_{in}$

✓ **Correct Answer: B) $C_{out} = (A \cdot B) + (C_{in} \cdot (A \oplus B))$**

Explanation: The Carry Out is generated if A and B are both 1, OR if the carry-in is 1 AND exactly one of A or B is 1 (generating a carry from the lower stage). This is mathematically represented by the given expression.

80

What does the "Don't Care" condition in a K-Map mean?

A The output is always 0

B The output is always 1

C The output can be treated as either 0 or 1 to maximize grouping ✓

D The circuit is broken

✓ **Correct Answer: C) The output can be treated as either 0 or 1 to maximize grouping**

Explanation: In some digital systems, certain input combinations never occur. For these combinations, the output is marked as "Don't Care" (usually an 'X'). In a K-Map, you can treat these Xs as 1s or 0s, whichever helps form larger groups and simplifies the final expression.

81

Which of the following is an application of Boolean functions in computers?

A Arithmetic Logic Units (ALUs)

B Data Processing

C Control Logic

D All of the above



✓ **Correct Answer: D) All of the above**

Explanation: Boolean functions are the foundation of all digital computing. They are used in ALUs for math, in data processing for managing binary data, and in control logic to coordinate the system's operations.

82

A 2-variable K-Map has how many possible minterms?

A 2

B 4



C 8

D 16

✓ **Correct Answer: B) 4**

Explanation: A 2-variable K-Map has $2^2 = 4$ cells, corresponding to 4 minterms (m0, m1, m2, m3).

83

If a K-Map group covers four 1s, how many variables does it eliminate in a 4-variable K-Map?

A 1

B 2



C 3

D 4

✓ **Correct Answer: B) 2**

Explanation: In an n-variable K-Map, a group of 2^k 1s eliminates k variables. For a group of 4 (2^2), it eliminates 2 variables, leaving a term with n-2 variables.

84 The expression $(A + B)'$ is equivalent to:

A $A' + B'$

B $A' \cdot B'$ ✓

C $A \cdot B$

D $A + B$

✓ **Correct Answer: B) $A' \cdot B'$**

Explanation: This is a direct application of De Morgan's Theorem. The complement of a sum is the product of the complements.

85

Which logic gate is used to generate the carry output in a half-adder?

A XOR

B OR

C AND



D NOT

✓ **Correct Answer: C) AND**

Explanation: The carry output is true only when both inputs are 1. This is the exact function of the AND gate ($A \cdot B$).

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Thank You!

Best of Luck for Your Exams

You have completed 85 MCQs on

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