CH # 2 BINARY SYSTEM

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2.1 INTRODUCTION TO NUMBER SYSTEMS

LONG QUESTIONS

Q.1 Define number system. Explain its types. **(K.B+U.B)**

Ans:

NUMBER SYSTEM

Definition:

A number system is the system for representation of numeric data.

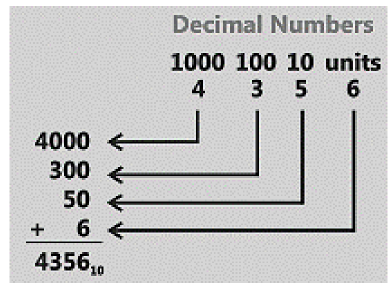
TYPES

There are three types of number system:

- Decimal
- Binary
- Hexadecimal

Decimal:

The number system we use in our daily life is the decimal number system. The decimal number system has base 10 as it uses ten digits (0 – 9). Each position represents a specific power of base 10.



Examples:

- $892 = 8 \times 10^2 + 9 \times 10^1 + 2 \times 10^0$
- $1247 = 1 \times 10^3 + 2 \times 10^2 + 4 \times 10^1 + 7 \times 10^0$
- $53 = 5 \times 10^1 + 3 \times 10^0$

Binary:

A computer understands the language of 1s and 0s only, called machine language. The number system that only contains 1s and 0s is called binary number system.

Explanation:

Binary number system has base 2 as all the numbers in this system consist of only two digits i.e. 0 and 1. Digital computers use this system to store data. Your name is in the form of alphabets, but for a computer each alphabet has some binary value.

Example:

The binary value of the letter 'A' is 01000001 and its decimal value is 65.

Hexadecimal:

Hexadecimal also used in our computer system. Hexadecimal system has total 16 numbers, i.e., 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F where A = 10, B = 11, C = 12, D = 13, E = 14 and F = 15

Examples:

3F2B

SHORT QUESTIONS

Q.1 Define decimal number system. **(K.B)**

Ans:

DECIMAL NUMBER SYSTEM

Definition:

The number system we use in our daily life is the decimal number system. The decimal number system has base 10 as it uses ten digits (0 – 9). Each position represents a specific power of base 10.

Examples:

- $892 = 8 \times 10^2 + 9 \times 10^1 + 2 \times 10^0$
- $1247 = 1 \times 10^3 + 2 \times 10^2 + 4 \times 10^1 + 7 \times 10^0$
- $53 = 5 \times 10^1 + 3 \times 10^0$

Q.2 What is hexadecimal number system? (K.B)

Ans:

HEXADECIMAL NUMBER SYSTEM

Hexadecimal also used in our computer system. Hexadecimal system has total 16 numbers, i.e., 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F where A = 10, B = 11, C = 12, D = 13, E = 14 and F = 15

Examples:

3F2B

MULTIPLE CHOICE QUESTIONS

1. A number system is the system for representation of: (K.B)

(A) Numeric Data (B) Alphabetic Data
(C) Alphanumeric Data (D) None of these

2. How many types of number system? (K.B+U.B)

(A) 2 (B) 3 (C) 4 (D) 5

3. Which type of number system is used in our daily life? (K.B+U.B)

(A) Decimal (B) Binary (C) Hexadecimal (D) None of these

4. The base of decimal number system is: (K.B)

(A) 2 (B) 10 (C) 8 (D) 16

5. 10^0 = (K.B+U.B+A.B)

(A) 0 (B) 1 (C) 10 (D) 100

6. Computer understand only ____________ language. (K.B)

(A) English (B) Urdu (C) Machine (D) Every type

7. The language that consists of only 1s and 0s is called: (K.B)

(A) English Language (B) Mathematics
(C) Machine Language (D) Programming Language

8. The number system that only contains 1s and 0s is called: (K.B)

(A) Decimal (B) Binary (C) Hexadecimal (D) None of these

9. Digital computers use ______________ system to store data. (K.B+U.B)

(A) Decimal (B) Binary (C) Both (D) None of these

10. The decimal value of letter 'A' is: (K.B)

(A) 4 (B) 16 (C) 65 (D) 100

11. The binary value of letter 'A' is: (K.B+A.B)

(A) 10001000 (B) 00011100 (C) 01000001 (D) 10010010

12. The base of binary number system is: (K.B)

(A) 2 (B) 10 (C) 8 (D) 16

13. The base of hexadecimal number system is: (K.B)

(A) 2 (B) 10 (C) 8 (D) 16

14. Hexadecimal system has total ___________ numbers. (K.B)

(A) 2 (B) 10 (C) 8 (D) 16

15. In hexadecimal number system, A = (K.B)

(A) 10 (B) 11 (C) 12 (D) 13

16. Which one is not a valid hexadecimal number? (K.B+U.B)

(A) 26 (B) A01 (C) 3F2B (D) 6G

17. Decimal number system is also called _____________, or Arabic, number system, in mathematics. (Do you Know Page # 34) **(K.B)**

(A) Roman (B) Hindu-Arabic (C) Natural (D) Both a & b

2.2 NUMBER SYSTEM CONVERSION

LONG QUESTIONS

Q.1 How can we convert decimal to binary and binary to decimal? Explain with examples. (U.B+A.B)

Ans:

DECIMAL TO BINARY CONVERSION

To convert a decimal number to binary, we divide the number by 2 and take quotient and remainder. We continue dividing the quotient by 2 until we get quotient 0. We write out all the remainders in reverse order to obtain the value in binary.

Example: Convert $(156)_{10}$ (156 in decimal) to binary

2	156
2	78 – 0
2	39 – 0
2	19 – 1
2	9 – 1
2	4 – 1
2	2 – 0
2	1 – 0
2	0 – 1

$156_{(10)} = 010011100_{(2)}$

BINARY TO DECIMAL CONVERSION

The conversion of a number from binary number system to decimal number system is explained below with the help of an example as follow

Example: Convert $(1000001)_2$ to decimal

$= 1 \times 2^6 + 0 \times 2^5 + 0 \times 2^4 + 0 \times 2^3 + 0 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$

$= 64 + 0 + 0 + 0 + 0 + 0 + 1$

$= 65$

$= (65)_{10}$

The above conversion is done by the following steps.

Step 1. Write down the binary number which is $(1000001)_2$ in this example.

Step 2. List the power of two from right to left starting with 0. In this example, the power of 2 starts from 0 and ends at 6.

Step 3. Multiply 2's corresponding powers to each binary value. In the above example there are 7 binary values.

Step 4. Compute each value.

Step 5. Add all the values.

Step 6. Write the answer along with its base subscript.

Q.2 How can we convert decimal to hexadecimal and hexadecimal to decimal? Explain with examples. (U.B+A.B)

Ans:

DECIMAL TO HEXADECIMAL CONVERSION

Hexadecimal number system has base 16, so for conversion of a number from decimal to hexadecimal, we divide the number by 16 and take both quotient and remainder. We continue dividing the quotient by 16 until the quotient becomes 0.

Example: Convert $(69610)_{10}$ to Hexadecimal

16	69610
16	4350 – 10
16	271 – 14
16	16 – 15
16	1 – 0
16	0 – 1

In a above table: A is representation of 10, remainder E is representation of 14, and remainder F is representation of 15. Remainders are taken from bottom to top to present the hexadecimal number. So, $(69610)_{10}$ = $(10FEA)_{16}$.

HEXADECIMAL TO DECIMAL CONVERSION

The method for this conversion is same as converting from binary to decimal except the base value. Since hexadecimal has base 16, the "place values" corresponds to the powers of 16. To convert to decimal, multiply each place value by the corresponding power of 16. Start this process by writing the powers of sixteen next to the digits of a hexadecimal number.

Example: Convert $(C921)_{16}$ to decimal

$= C \times 16^3 + 9 \times 16^2 + 2 \times 16^1 + 1 \times 16^0$

$=12 \times 16^3 + 9 \times 16^2 + 2 \times 16^1 + 1 \times 16^0$

$=12 \times 4096 + 9 \times 256 + 2 \times 16 + 1 \times 1$

$= 49152 + 2304 + 32 + 1$

$= 51489$

$= (51489)_{10}$

Q.3 How can we convert hexadecimal to binary and binary to hexadecimal? Explain with examples. (U.B+A.B)

Ans:

HEXADECIMAL TO BINARY CONVERSION

To convert a hexadecimal number to binary, simply convert each hexadecimal digit to four digits value. To find the four digits binary value, we use the table as follows:

Hexadecimal	Binary
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001
A	1010
B	1011
C	1100
D	1101
E	1110
F	1111

Example: Convert $(A23)_{16}$ (A23 in hexadecimal) to binary

In this number, there are three hexadecimal digits. Binary of each digit is given as:

i. For A, the binary value is 1010

ii. For 2, the binary value is 0010

iii. For 3, the binary value is 0011

By combining all the binary values, we get 1010 0010 0011

So, $(A23)_{16}$ = $(101000100011)_2$

BINARY TO HEXADECIMAL CONVERSION

This conversion is also very easy with the help of table. In the given binary number, we start making groups of four digits from right to left and replace every group with a hexadecimal digit.

Example: Convert $(11000001)_2$ to hexadecimal.

The four digits binary groups in this binary number are given below where each group has four binary digits.

1100 0001

i. For 1100, the hexadecimal is C

ii. For 0001 the hexadecimal is 1

So, $(11000001)_2 = (C1)_{16}$

While making groups from right to left, if the left group has less than 4 binary digits then we simply add 0s on the left. For example, 1010011 has groups 1010011 and by adding one 0 on the left it becomes 0101 0011.

SHORT QUESTIONS

Q.1 Convert $(70C558)_{16}$ to binary. (A.B)

Ans: **CONVERSION**

To convert a hexadecimal number to binary, simply convert each hexadecimal digit to four digits value. To find the four digits binary value, we use this table:

Hexadecimal	Binary
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001
A	1010
B	1011
C	1100
D	1101
E	1110
F	1111

In this number, there are three hexadecimal digits. Binary of each digit is given as:

i. For 7, the binary value is 0111

ii. For 0, the binary value is 0000

iii. For C, the binary value is 1100

iv. For 5, the binary values 0101

v. For 5, the binary value is 0101

vi. For 8, the binary value is 1000

By combining all the binary values, we get 0111 0000 1100 0101 0101 1000

So, $(70C558)_{16} = (011100001100010101011000)_2$.

Q.2 Convert $(110101111)_2$ to hexadecimal. **(A.B)**

Ans:

CONVERSION

Hexadecimal	Binary
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001
A	1010
B	1011
C	1100
D	1101
E	1110
F	1111

The groups in this binary number are given below where each group has maximum four binary digits.

110101111

The left most group has only 1 binary digit and by adding 0s, we get:

0001 1010 1111

We replace each group with the respective hexadecimal and get:

1AF

So, $(110101111)_2 = (1AF)_{16}$

ACTIVITY QUESTIONS

Activity 2.1 (A.B)
How many marks did you obtain in the final examination of 8th class? Convert that figure to binary and discuss the result with your class fellows.

SOLUTION

I got 640 marks in the final examination of 8th class.

CONVERSION INTO BINARY

2	640
2	320 – 0
2	160 – 0
2	80 – 0
2	40 – 0
2	20 – 0
2	10 – 0
2	5 – 0
2	2 – 1
2	1 – 0
2	0 – 1

$640_{(10)} = 01010000000_{(2)}$

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Activity 2.2 (A.B)

Exchange your marks in binary form with your friends and convert them in decimal to know about their expectations in the board examination of 9th class. Double check with your class fellows that how much your calculations are accurate.

SOLUTION

My friend gave this binary number: 11101110

CONVERSION INTO DECIMAL

11101110

$= 1 \times 2^7 + 1 \times 2^6 + 1 \times 2^5 + 0 \times 2^4 + 1 \times 2^3 + 1 \times 2^2 + 1 \times 2^1 + 0 \times 2^0$

$= 128 + 64 + 32 + 0 + 8 + 4 + 2 + 0$

$= 238$

$= (238)_{10}$

According to this activity my expected board marks of class 9th is 238.

Activity 2.3 (A.B)

According to Table 2-2, write in decimal, binary, and hexadecimal the time of your:

- Arrival at school
- Lunch
- Playing

Decimal	Binary	Hexadecimal	Decimal	Binary	Hexadecimal
0	0	0			
1	1	1	11	1011	B
2	10	2	12	1100	C
3	11	3	13	1101	D
4	100	4	14	1110	E
5	101	5	15	1111	F
6	110	6	16	10000	10
7	111	7	17	10001	11
8	1000	8	18	10010	12
9	1001	9	19	10011	13
10	1010	A	20	10100	14

Table 2-2

SOLUTION

Number systems	Decimal	Binary	Hexadecimal
Arrival at school	8: 00	1000: 0000	8: 00
Lunch	2: 10	0010: 1010	2: A
Playing	6: 15	0110: 1111	6: F

Activity 2.4 (A.B)

Many online convertors for number systems are available. Try to find and use them. You can ask your class teacher to help in searching.

SOLUTION

Online converters that I have used:

https://coderstoolbox.net/number/

https://codebeautify.org/all-number-converter

https://www.rapidtables.com/convert/number/base-converter.html

Activity 2.5 (A.B)

Try to calculate that the binary of C92116 which is 110010010010000100010110

SOLUTION

To convert a hexadecimal number to binary, simply convert each hexadecimal digit to four digits value. To find the four digits binary value, we use the table as follows:

Hexadecimal	Binary
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001
A	1010
B	1011
C	1100
D	1101
E	1110
F	1111

In this number, there are three hexadecimal digits. Binary of each digit is given as:

- For C, the binary value is 1100
- For 9, the binary value is 1001
- For 2, the binary value is 0010
- For 1, the binary values 0001
- For 1, the binary value is 0001
- For 6, the binary value is 0110

By combining all the binary values, we get 1100 1001 0010 0001 0001 0110

So, $(C92116)_{16} = (110010010010000100010110)_{2}$.

MULTIPLE CHOICE QUESTIONS

1. To convert a decimal number to binary, we divide the number by: (A.B)

(A) 2 (B) 3 (C) 4 (D) 5

2. $2_{(10)}$ = (K.B+U.B+A.B)

(A) 0 (B) 1 (C) 10 (D) None of these

3. $A_{(16)}$ is equivalent in binary value: (K.B+U.B+A.B)

(A) 0 (B) 1 (C) 10 (D) 1010

4. 1.0 = (K.B+U.B+A.B)

(A) 0 (B) 1 (C) 10 (D) cannot be calculated

2.3 MEMORY AND DATA STORAGE

LONG QUESTIONS

Q.1 Define memory. Explain its types. (K.B+U.B)

Ans:

MEMORY

Definition:

Computer memory is any physical device capable of storing data.

TYPES OF MEMORY

Primarily there are following two types of memory.

- Volatile Memory
- Non-Volatile Memory

VOLATILE MEMORY (PRIMARY STORAGE)

Definition:

A device which holds data as long as it has power supply connected to it, is called Volatile Memory.

Example:

Its best example is Random Access Memory (RAM), which holds memory only as long as it is connected to power source. As soon as the power supply is disconnected, all the data in RAM is cleared.

NON-VOLATILE MEMORY (SECONDARY STORAGE)

Definition:

A device which can hold data even if it is not connected to any power source, is called Non-Volatile Memory.

Example:

The typical examples for Non-Volatile Memory are hard drives, flash drives and memory cards installed in cell phones. Even if you turn off your PC, the data in your hard drive or flash drive stays intact.

Q.2 How data represent in computer memory? (U.B)

Ans:

DATA REPRESENTATION IN COMPUTER MEMORY

Digital computers store data in binary form. It means that whether it is a text, picture, movie or some application, it is stored in computer's memory in the form of 0s and 1s. All the characters on your keyboard has an associated code in binary. This code is called ASCII code of the character. ASCII stands for American Standard Code for information Interchange. It is a de-facto standard for representation of data inside computer's memory.

The following table presents the ASCII table which shows the code against each character on your keyboard. The codes are given in decimal form, but inside computer's memory they are represented after conversion to binary form.

Code	Character	Description	Code	Character	Description
32	SP	Space	80	P	
33	!	Exclamation mark	81	Q	
34	"	Double quote	82	R	
35	#	Number sign	83	S	
36	$	Dollar sign	84	T	
37	%	Percent	85	U	
38	&	Ampersand	86	V	

39	'	Single quote	87	W	
40	(	Left/opening parenthesis	88	X	
41	)	Right/opening parenthesis	89	Y	
42	*	Asterisk	90	Z	
43	+	Plus	91	[	Left/opening bracket
44	,	Comma	92	\	Back slash
45	-	Minus or dash	93	]	Right/closing bracket
46	.	Dot	94	^	Caret/circumflex
47	/	Forward slash	95	_	underscore
48	0		96	`	
49	1		97	a	
50	2		98	b	
51	3		99	c	
52	4		100	d	
53	5		101	e	
54	6		102	f	
55	7		103	g	
56	8		104	h	
57	9		105	i	
58	:	Colon	106	j	
59	;	Semi-colon	107	k	
60	<	Less than	108	l	
61	=	Equal sign	109	m	
62	>	Greater than	110	n	
63	?	Question mark	111	o	
64	@	"at" symbol	112	p	
65	A		113	q	
66	B		114	r	
67	C		115	s	
68	D		116	t	
69	E		117	u	
70	F		118	v	
71	G		119	w	
72	H		120	x	
73	I		121	y	
74	J		122	z	
75	K		123	{	Left/opening brace
76	L		124	|	Vertical bar
77	M		125	}	Right/closing brace
78	N		126	~	Tilde
79	O		127	DEL	Delete

Example:

To store name of our country "Pakistan" in computer's memory. We need to store code of each letter in one byte. As the word "Pakistan" contains 8 letters, so 8 bytes are required for storage. It is demonstrated as follows:

Human's View About Memory	Code in Decimal	Code in Binary
'P'	80	01010000
'a'	97	01100001
'k'	107	01101011
'i'	105	01101001
's'	115	01110011
't'	116	01110100
'a'	97	01100001
'n'	110	01101110

SHORT QUESTIONS

Q.1 Define memory. **(K.B)**

Ans:

MEMORY

Definition:

Computer memory is any physical device capable of storing data.

Types:

Primarily there are following two types of memory:

- Volatile Memory
- Non-Volatile Memory

Q.2 What is ASCII code? **(K.B)**

Ans:

ASCII CODE

Definition:

All the characters on your keyboard has an associated code in binary. This code is called ASCII code of the character. ASCII stands for American Standard Code for information Interchange. It is a de-facto standard for representation of data inside computer's memory.

Q.3 Write briefly about storage devices. **(K.B+U.B)**

Ans:

STORAGE DEVICES

Any computing hardware that is used for storing, porting and extracting data, is called a storage device. It can hold or store information both temporarily and permanently. It can also be internal or external to a computer. An external storage device is a plug and play device, i.e., we just plug it to some port and start using it without turning off a computer. To attach an internal storage device (Hard disk or RAM) we need to turn off the computer. Internal storage devices area connected to some fixed slots.

Examples:

Examples of storage devices are:

- RAM
- Hard disk
- CD
- USB Flash Drive etc.

Q.4 What is difference between memory and storage? **(K.B+U.B)**

Ans:

DIFFERENTIATION

The differences between memory and storage are as follows:

Memory	Storage
Definition	

It is a place where an application loads its data during processing.	It is a place where data is stored for long or short term.
Storage Type	
It is a temporary storage device.	It is a permanent storage device.
Size	
It is lesser in size.	It is greater in size.
Speed	
It has high accessing speed.	It has low accessing speed.
Another Name	
It is called primary memory.	It is called secondary memory.
Examples	
RAM is an example of memory.	Hard disk is an example of storage.

MULTIPLE CHOICE QUESTIONS

1. **Types of memory are:** **(K.B)**
   (A) 2 (B) 3 (C) 4 (D) 5
2. **Volatile memory also called:** **(K.B+U.B)**
   (A) Primary storage (B) Secondary storage
   (C) Memory card (D) Not a memory
3. **RAM is an example of:** **(K.B)**
   (A) Primary storage (B) Secondary storage
   (C) Memory card (D) Not a memory
4. **Hard drive is an example of:** **(K.B)**
   (A) Volatile memory (B) Non-volatile memory
   (C) Both (D) None of these
5. **Digital computer stored data in:** **(K.B)**
   (A) Decimal form (B) Binary form
   (C) Alphabetic form (D) Both A & B
6. **The ASCII code for 'B' is:** **(K.B+U.B)**
   (A) 10 (B) 54 (C) 66 (D) 98

ACTIVITY QUESTIONS

Activity 2.6 (A.B)

Write your complete name and give its presentation in binary format.

SOLUTION

My name is "Kips"

Human's View About Memory	Code in Decimal	Code in Binary
'K'	75	01001011
'i'	105	01101001
'p'	112	01110000
's'	115	01110011

My name is "01001011011010010111000001110011"

2.4 MEASUREMENT OF SIZE OF COMPUTER MEMORY

LONG QUESTION

Q.1 Write a note on measurement of size of computer memory. **(K.B+U.B)**

Ans: **MEASUREMENT OF SIZE OF COMPUTER MEMORY**

Bit:

The smallest amount of data to be stored in computer's memory is a 0 or 1. It is called a bit.

Byte:

A collection of eight bit is called a byte. At least one byte is required to store any piece of information in a computer's storage. On both primary and secondary storage devices, data is stored in the form of bytes.

Units of Data:

The following table shows different units of data are given.

Unit	Size
Bit	Smallest unit of data, can hold only one value: 0 or 1
Byte	Group of eight bits, enough space to store single ASCII character
Kilobyte	1KB = 1,024 bytes
Megabyte	1MB = (1,024) KB or $(1,024)^2$ bytes
Gigabyte	1GB = 1,024 MB or $(1,024)^3$ bytes
Terabyte	1TB = 1,024 GB or $(1,024)^4$ bytes
Petabyte	1PB = 1,024 TB or $(1,024)^5$ bytes

SHORT QUESTIONS

Q.1 Define bit and byte. **(K.B)**

Ans: **DEFINITIONS**

Bit:

The smallest amount of data be stored in computer's memory is a 0 or 1. It is called a bit. Bit is also called a binary digit.

Byte:

A collection of eight bit is called a byte. At least one byte is required to store any piece of information in a computer's storage. On both primary and secondary storage devices, data is stored in the form of bytes.

MULTIPLE CHOICE QUESTIONS

1. 1Kb = **(K.B+U.B+A.B)**

(A) 1000 bits (B) 1024 bits (C) 1024 bytes (D) 1 MB

2. 1Gb = **(K.B+U.B+A.B)**

(A) 1024 bytes (B) 1024 KB (C) 1024 MB (D) 1024 TB

3. TB stands for: **(K.B)**

(A) Test Byte (B) Tri byte (C) Tera byte (D) Test Bit

4. 1 Tera Byte = **(K.B+U.B+A.B)**

(A) $(1024)^2$ Bytes (B) $(1024)^3$ Bytes (C) $(1024)^4$ Bytes (D) $(1024)^5$ Bytes

5. 1 Megabyte = **(K.B+U.B)**

(A) $(1024)^2$ Bytes (B) $(1024)^3$ Bytes (C) $(1024)^4$ Bytes (D) $(1024)^5$ Bytes

2.5 BOOLEAN ALGEBRA

LONG QUESTIONS

6. Q.1 Define logical operators discuss its types. **(K.B+U.B)**

Ans:

LOGICAL OPERATORS

Definition:

A logical operator is a symbol or word used to connect two or more expressions such that the value of the compound expression produced depends only on that of the original expressions and on the meaning of the operator.

TYPES OF LOGICAL OPERATORS

There are three types of logical operators:

- AND
- OR
- NOT

AND Operator (●):

If we used "AND" operator to connect two or more propositions, then the compound proposition is true only if all the connected propositions are true. AND operator can also be denoted by a dot "·" Symbol. It means that P AND Q may also written as P·Q.

Truth Table for AND operator:

The following truth table for P AND Q is given below. The first two columns are showing all the possible combinations of truth values of proposition P and Q, the third column is showing the resultant truth value of P AND Q.

Assume:

P = It is raining

Q = Today is Sunday

P and Q = It is raining and today is Sunday

P	Q	P AND Q
T	T	T
T	F	F
F	T	F
F	F	F

OR Operator (+):

We can also use "OR" operator to connect two or more propositions e.g. "Today is Monday OR I am in School". In case of OR operator, the compound proposition is true if at least one proposition is true. In other words, the compound proposition is false only if all the propositions are false. OR operator can also be denoted by a plus "+" symbol. It means that P OR Q may also be written as P + Q.

Truth Table for OR operator:

For the same propositions P and Q, let's see the truth table for the expression P OR Q. P OR Q = "It is raining or it is Sunday". This compound proposition is False if it is not raining and today is not Sunday otherwise it is True.

P	Q	P OR Q
T	T	T
T	F	T
F	T	T

F	F	F

Not Operator:

The logical operator "NOT" is not a connector but it is used to negate a proposition. For example, if P = "Today is Monday" then NOT (P) means "Today is not Monday". So, with NOT operator a True value becomes false and vice versa. Not operator can also be denoted by a " ¬" symbol. It means that NOT (P) may also be written as ¬P.

Truth Table for NOT operator:

We can also make truth table where NOT operator is used. Negation (also called NOT) is an operator that reverse the nature of a value, i.e. a value True becomes False and vice versa.

The truth table for NOT operator is:

P	NOT (P)
T	F
F	T

Q.2 Define Boolean algebra. Describe laws of Boolean algebra. (K.B+U.B)

Ans:

BOOLEAN ALGEBRA

Definition:

Boolean algebra is the algebra of logic. It uses symbol to represent logical statements instead of words. Boolean algebra was formulated by the English Mathematician George Boole in 1847. Boolean algebra returns results in terms of true or false i.e. 1 or 0 respectively.

LAWS OF BOOLEAN ALGEBRA

The laws of Boolean Algebra help us to simplify complex Boolean expressions. Some laws are discussed in the following:

Commutative law:

Commutative Law states that the order of application of two separate propositions is not important. So,

(a) A · B = B · A (The order in which two variables are AND'ed makes no difference.)

(b) A + B = B + A (The order in which two variables are OR'ed makes no difference.

Associative Law:

This law is for several variables. According to this law there is no change in results if a grouping of expressions is changed. This law is quite same in case of AND and OR operations.

(a) (A + B) + C = A + (B + C)

(b) (A · B) · C = A · (B · C)

Distribution Law:

This law is discussed in two ways, i.e., "AND over OR" and "OR over AND".

(a) A · (B + C) = (A · B) + (A · C) (AND over OR)

(b) A + (B · C) = (A + B) · (A + C) (OR over AND)

Identity Law:

If a variable is OR'ed with a False, the result is always equal to that variable. And if a variable is AND'ed with a True, the result is always equal to that variable.

(a) A OR False = A, A variable OR'ed with False is always equal to that variable.

(b) A AND True = A, A variable AND'ed with True is always equal to that variable.

Q.3 State and prove associative law. **(K.B+U.B+A.B)**

Ans:

ASSOCIATIVE LAW

This law is for several variables. According to this law there is no change in results if a grouping of expressions is changed. This law is quite same in case of AND and OR operations.

(a) $(A + B) + C = A\,(B + C)$

(b) $(A \cdot B) \cdot C = A \cdot (B \cdot C)$

In order to verify the associative law for OR operation, we can observe the Truth Table:

A	B	C	A+B	B+C	(A + B) + C	A + (B + C)
F	F	F	F	F	F	F
F	F	T	F	T	T	T
F	T	F	T	T	T	T
F	T	T	T	T	T	T
T	F	F	T	F	T	T
T	F	T	T	T	T	T
T	T	F	T	T	T	T
T	T	T	T	T	T	T

A	B	C	A · B	B · C	(A · B) · C	A · (B · C)
F	F	F	F	F	F	F
F	F	T	F	F	F	F
F	T	F	F	F	F	F
F	T	T	F	T	F	F
T	F	F	F	F	F	F
T	F	T	F	F	F	F
T	T	F	T	F	F	F
T	T	T	T	T	T	T

Q.4 State and prove distributive law. **(K.B+U.B+A.B)**

Ans:

DISTRIBUTIVE LAW

This law is discussed in two ways, i.e., "AND over OR" & OR over AND".

(a) $A \cdot (B + C) = (A \cdot B) + (A \cdot C)$ (AND over OR)

(b) $A + (B \cdot C) = (A + B) \cdot (A + C)$ (OR over AND)

We can verify the distribution law for (AND over OR) operation by using Table.

A	B	C	B + C	A · B	A · C	A · (B + C)	(A · B) + (A · C)
F	F	F	F	F	F	F	F
F	F	T	T	F	F	F	F
F	T	F	T	F	F	F	F
F	T	T	T	F	F	F	F
T	F	F	F	F	F	F	F
T	F	T	T	F	T	T	T
T	T	F	T	T	F	T	T
T	T	T	T	T	T	T	T

A	B	C	B · C	A + B	A + C	A + (B · C)	(A + B) · (A + C)
F	F	F	F	F	F	F	F
F	F	T	F	F	T	F	F
F	T	F	F	T	F	F	F
F	T	T	T	T	T	T	T
T	F	F	F	T	T	T	T
T	F	T	F	T	T	T	T
T	T	F	F	T	T	T	T
T	T	T	T	T	T	T	T

SHORT QUESTIONS

Q.1 Define Boolean algebra. (K.B)

Ans: **<u>BOOLEAN ALGEBRA</u>**

Definition:

Boolean algebra is the algebra of logic. It uses symbol to represent logical statements instead of words. Boolean algebra was formulated by the English Mathematician George Boole in 1847. Boolean algebra returns results in terms of true or false i.e. 1 or 0 respectively.

Q.2 What is Boolean proposition? (K.B)

Ans: **<u>BOOLEAN PROPOSITION</u>**

Definition:

A proposition is a sentence that can either be true of false.

Example:

The following sentences are propositions.

1. "I want to excel in mathematics".

2. "I play chess".

But the following sentences are not propositioning.

1. How are you?

2. Close the door.

We can also assign some letter to a proposition, as show in the following.

1. P = "I play chess".

2. Q = "I want to excel in mathematics".

Now, when we say P, it means that we are referring to proposition "I play chess". And when we say Q, it means that we are referring to proposition "I want to excel in mathematics".

Q.3 Define truth values. (K.B)

Ans: **<u>TRUTH VALUES</u>**

Definition:

Every proposition takes one of two values true or false, and these values are called the truth values. Truth value is given on the basis of truthfulness or falsity of a proposition.

Example:

Assume P = "Islamabad is the capital of Pakistan". You can assign the truth value true to this proposition.

Now assume another proposition Q = "The sun rises in the west". The truth value for this proposition is false.

If we have proposition R = "I have completed my homework", the truth value depends on the person who is assigning it. If a person has completed his homework then he can assign truth value true, otherwise false.

Q.4 What is meant by compound proposition? (K.B)

Ans:

COMPOUND PROPOSITION

Sometimes was assemble more than one propositions to make one proposition called compound proposition.

Example:

If we have the following two propositions.

- Today is Monday.
- I am in school.

Then "Today is Monday AND I am in school" is a compound proposition. Truth value of the compound proposition depends upon the truth values of the individual's propositions and the logical operator used to connect the propositions. In this example "AND" is a logical operator.

Q.5 What is the purpose of truth table? (K.B)

Ans:

TRUTH TABLE

A truth table is used to check whether a proposition is True or False. Usually it is used to check the truth value of a proposition where some logical operator is used.

Q.6 How can we make truth for complex problem? (U.B)

Ans:

TRUTH TABLE FOR COMPLEX BOOLEAN EXPRESSIONS

We can make truth table for example, if we need to make a truth table of "It is not raining and today is Sunday". It means the proposition NOT(P) AND Q. The truth table for this compound proposition is:

P	NOT (P)	Q	NOT (P) AND Q
T	F	T	F
T	F	F	F
F	T	T	T
F	T	F	F

Q.5 State and prove commutative law. (K.B+U.B+A.B)

Ans:

COMMUTATIVE LAW

Commutative Law states that the order of application of two separate propositions is not important. So,

(a) $A \cdot B = B \cdot A$ (The order in which two variables are AND'ed makes no difference.)

(b) $A + B = B + A$ (The order in which two variables are OR'ed makes no difference.

We can use truth tables to verify this law for AND and OR operations respectively.

A	B	A · B	B · A
F	F	F	F
F	T	F	F
T	F	F	F
T	T	T	T

A	B	A + B	B + A
F	F	F	F
F	T	T	T
T	F	T	T
T	T	T	T

Q.7 State associative law. (K.B+U.B+A.B)

Ans:

ASSOCIATIVE LAW

This law is for several variables. According to this law there is no change in results if a grouping of expressions is changed. This law is quite same in case of AND and OR operations.

(a) (A + B) + C = A (B + C)

(b) (A · B) · C = A · (B · C)

Q.8 Prove the following property. **(U.B+A.B)**

(A + B) + C = A + (B + C)

Ans: In order to verify the associative law for OR operation, we can observe the Truth Table presented in the following table. Both columns (A + B) + C and A + (B + C) contains same values in each row. It verifies the associative law for OR operation.

A	B	C	A + B	B + C	(A + B) + C	A + (B + C)
F	F	F	F	F	F	F
F	F	T	F	T	T	T
F	T	F	T	T	T	T
F	T	T	T	T	T	T
T	F	F	T	F	T	T
T	F	T	T	T	T	T
T	T	F	T	T	T	T
T	T	T	T	T	T	T

Q.9 Prove the following property. **(U.B+A.B)**

(A . B) . C = A . (B . C)

Ans:

A	B	C	A · B	B · C	(A · B) · C	A · (B · C)
F	F	F	F	F	F	F
F	F	T	F	F	F	F
F	T	F	F	F	F	F
F	T	T	F	T	F	F
T	F	F	F	F	F	F
T	F	T	F	F	F	F
T	T	F	T	F	F	F
T	T	T	T	T	T	T

Q.10 State distributive law. **(K.B)**

Ans:

<u>DISTRIBUTIVE LAW</u>

This law is discussed in two ways, i.e., "AND over OR", "OR over AND".

(a) A · (B + C) = (A · B) + (A · C) (AND over OR)

(b) A + (B · C) = (A + B) · (A + C) (OR over AND)

Q.11 Prove distributive law "AND over OR". **(K.B+U.B+A.B)**

Ans:

<u>DISTRIBUTIVE LAW</u>

A · (B + C) = (A · B) + (A · C) (AND over OR)

A	B	C	B + C	A · B	A · C	A · (B + C)	A · B + A · C
F	F	F	F	F	F	F	F
F	F	T	T	F	F	F	F
F	T	F	T	F	F	F	F
F	T	T	T	F	F	F	F
T	F	F	F	F	F	F	F
T	F	T	T	F	T	T	T
T	T	F	T	T	F	T	T
T	T	T	T	T	T	T	T

Q.12 Prove distributive law "OR over AND". (K.B+U.B+A.B)

Ans:

<u>DISTRIBUTIVE LAW</u>

A + (B · C) = (A + B) · (A + C) (OR over AND)

A	B	C	B · C	A + B	A + C	A + (B · C)	(A + B) · (A + C)
F	F	F	F	F	F	F	F
F	F	T	F	F	T	F	F
F	T	F	F	T	F	F	F
F	T	T	T	T	T	T	T
T	F	F	F	T	T	T	T
T	F	T	F	T	T	T	T
T	T	F	F	T	T	T	T
T	T	T	T	T	T	T	T

Q.13 State identity law. (K.B)

Ans:

<u>IDENTITY LAW</u>

If a variable is OR'ed with a False, the result is always equal to that variable. And if a variable is AND'ed with a True, the result is always equal to that variable.

(a) A OR False = A, A variable OR'ed with False is always equal to that variable.

(b) A AND True = A, A variable AND'ed with True is always equal to that variable.

Q.14 Prove A + 0 = A. (U.B+A.B)

Ans:

<u>PROVE</u>

A	A + 0
0	0 + 0 = 0
1	1 + 0 = 1

Q.15 Prove A · 1 = A. (U.B+A.B)

Ans:

<u>PROVE</u>

A	A · 1
0	0 · 1 = 0
1	1 · 1 = 1

Q.16 What are logical expressions. (K.B)

Ans:

<u>LOGICAL EXPRESSIONS</u>

We get a logical expression when some logical operator is applied to the Boolean proposition(s).

<u>Examples</u>:

- P AND Q
- ¬(P OR Q)
- P OR Q etc.

MULTIPLE CHOICE QUESTIONS

1. **Which one are Boolean values? (U.B)**
   (A) True, False (B) Hardware, Software
   (C) Memory, Storage (D) Input, Output
2. **Idea of Boolean values is given by: (K.B+U.B)**
   (A) Bill Gates (B) Einstein (C) George Boole (D) Newton
3. **A proposition is a sentence that can either be ____________. (K.B)**
   (A) True, False (B) Hardware, Software (C) Memory, Storage (D) Input, Output

4. **Which one is not a proposition? (U.B)**
(A) I will get A+ grade in board exam. (B) I want to excel in mathematics.
(C) Is its hot outside? (D) I play chess.

5. **Every proposition takes one of two values true or false, and these values are called: (K.B)**
(A) Boolean algebra (B) Proposition (C) Storage (D) Truth values

6. **Assume P = "Islamabad is the capital of Pakistan". What is the truth value? (U.B+A.B)**
(A) True (B) False (C) Both (D) None of these

7. **Assume Q = "The sun rises in the west". The truth value for this proposition is? (U.B+A.B)**
(A) True (B) False (C) Both (D) None of these

8. **Sometimes was assemble more than one propositions to make one proposition called: (K.B)**
(A) Boolean algebra (B) Proposition
(C) Compound proposition (D) Truth values

9. **Combine the following two propositions with AND operator: (A.B)**
1. Today is Monday 2. I am in school
(A) Today is Monday OR I am in school.
(B) Today is Monday AND I am in school.
(C) Today is NOT Monday OR I am NOT in school.
(D) Today is NOT Monday AND I am NOT in school.

10. **The symbol of AND operator is: (K.B)**
(A) + (B) · (C) ¬ (D) ×

11. **The symbol of OR operator is: (K.B)**
(A) + (B) · (C) ¬ (D) ×

12. **The symbol of NOT operator is: (K.B)**
(A) + (B) · (C) ¬ (D) ×

13. **If we use "AND" operator to connect two or more propositions, then the compound proposition is true only if all the connected propositions are _______. (U.B)**
(A) True (B) False (C) Both (D) None of these

14. **If we used "AND" operator to connect two or more propositions, the value of first proposition is true and other is false then the result is: (U.B)**
(A) True (B) False (C) Both (D) None of these

15. **If we used "OR" operator to connect two or more propositions, then the compound proposition is false only if all the connected propositions are _______. (U.B)**
(A) True (B) False (C) Both (D) None of these

16. **If we used "OR" operator to connect two or more propositions, the value of first proposition is true and other is false then the result is: (U.B)**
(A) True (B) False (C) Both (D) None of these

17. **P OR Q also written as: (U.B+A.B)**
(A) P · Q (B) P + Q (C) P ¬ Q (D) P × Q

18. **If P = "Today is Monday" then NOT (P) means: (U.B+A.B)**
(A) Today is Monday. (B) And today is Monday.
(C) Or today is not Monday. (D) Today is not Monday.

19. **Which one is not a logical operator? (U.B)**
(A) AND (B) NEITHER (C) OR (D) NOT

20. **Which operator is not a connector? (U.B)**
(A) AND (B) NOT (C) OR (D) All

21. If P = True then ¬P = **(A.B)**
(A) True (B) False (C) Both (D) None of these

22. The formula of making all possible combination of proposition: **(U.B)**
(A) n^2 (B) 2^n (C) n^n (D) None of these

23. If n = 2 propositions then total possibilities are: **(U.B)**
(A) 2 (B) 4 (C) 1 (D) 8

24. If
P = It is raining.
Q = Today is Sunday.
P and Q = It is raining and today is Sunday.
Then what is exactly the statement if P and Q is FALSE **(U.B+A.B)**
(A) It is raining on Sunday. (B) It is raining but not on Sunday.
(C) It is not raining but today is Sunday. (D) It is neither raining nor Sunday".

25. If P = T and Q = F, then what is result of NOT (P) AND Q? **(U.B+A.B)**
(A) T (B) F (C) Both (D) None of these

26. According to commutative law: A + B = **(K.B+U.B)**
(A) B · A (B) B + A
(C) ¬ A + B (D) None of these

27. The distributive law: **(K.B+U.B)**
(A) (A + B) + C = A · (B + C) (B) A + B = B + A
(C) A + (B · C) = (A + B) · (A + C) (D) None of these

28. A + 0 = **(K.B+U.B)**
(A) 1 (B) 0 (C) A (D) ¬A

29. P = **(K.B+U.B)**
(A) ¬P (B) ¬¬P (C) ¬¬¬P (D) All of these

30. If P = It is sunny today. ¬P = It is not sunny today.
Then what is result of ¬ ¬P **(K.B+U.B)**
(A) It is sunny today. (B) It is not sunny today.
(C) It is sunny not today. (D) None of these

ACTIVITY QUESTIONS

Activity 2.7 (A.B)

Draw the truth table to verify A + (B · C) = (A + B) · (A + C)

SOLUTION

This is called distributive law "OR over AND".

A + (B · C) = (A + B) · (A + C) (OR over AND)

A	B	C	B · C	A + B	A + C	A + (B · C)	(A + B) · (A + C)
F	F	F	F	F	F	F	F
F	F	T	F	F	T	F	F
F	T	F	F	T	F	F	F
F	T	T	T	T	T	T	T
T	F	F	F	T	T	T	T
T	F	T	F	T	T	T	T
T	T	F	F	T	T	T	T
T	T	T	T	T	T	T	T

EXERCISE

1.1 Multiple Choice Questions:

1. Expression (A + B) · (A + C) is equal to ________. **(K.B+U.B)**

(i) A + (B · C) **(ii)** A · B + A · C
(iii) A · (B · C) **(iv)** A + (B + C)

2. The order of application of two separate terms is not important in_________. **(U.B)**

(i) Associative Law **(ii)** Commutative Law
(iii) Distribution Law **(iv)** Identity Law

3. "Is it cold outside" is _________. **(U.B)**

(i) Boolean Proposition **(ii)** Categorical proposition
(iii) Moral preposition **(iv)** None of above

4. Number "17" is equal to _________ in binary system. **(A.B)**

(i) 10000 **(ii)** 10110
(iii) 10001 **(iv)** 10100

5. 1 Petabyte is equal to ___________. **(K.B+U.B)**

(i) $(1{,}024)^4$ bytes **(ii)** $(1{,}024)^6$ bytes
(iii) $(1{,}024)^5$ bytes **(iv)** $(1{,}024)^7$ bytes

6. Hexadecimal system has total ________ numbers. **(K.B+U.B)**

(i) 17 **(ii)** 16
(iii) 18 **(iv)** 15

ANSWERS

1	(i)	2	(ii)	3	(i)	4	(iii)	5	(iii)
6	(ii)								

1.2 Answer the following questions.

1. Convert $(69610)_{10}$ to Hexadecimal. **(A.B)**

Ans:

CONVERSION

16	69610
16	4350 – 10
16	271 – 14
16	16 – 15
16	1 – 0
16	0 – 1

A is representation of 10, remainder E is representation of 14, and remainder F is representation of 15. Remainders are taken from bottom to top to present the hexadecimal number. So, $(69610)_{10} = (10FEA)_{16}$.

2. Differentiate between volatile and non-volatile memory. **(K.B+U.B)**

Ans:

DIFFERENTIATE

The difference between volatile and non-volatile memory is as follows:

Volatile Memory	Non-volatile Memory
Definition	
A device which holds data as long as it has power supply connected to it, is called Volatile Memory	A device which can hold data even if it is not connected to any power source, is called Non-Volatile Memory.
Example	
Its best example is Random Access Memory (RAM), which holds memory only as long as it is connected to power source. As soon as the power supply is disconnected, all the data in RAM is cleared.	The typical examples for Non-Volatile Memory are hard drives, flash drives and memory cards installed in cell phones. Even if you turn off your PC, the data in your hard drive or flash drive stays intact.

Storage Type	
It is a temporary storage device.	It is a permanent storage device.
Speed	
It has high accessing speed.	It has low accessing speed.
Another Name	
It is called primary memory.	It is called secondary memory.

3. Store the word "Phone" in computer memory starting from address 7003 where each letter needs one byte to store in the memory. (A.B)

Ans: **<u>STORE IN COMPUTER MEMORY</u>**

ASCII table of characters is given below:

Code	Character	Description	Code	Character	Description
32	SP	Space			
65	A		97	a	
66	B		98	b	
67	C		99	c	
68	D		100	d	
69	E		101	e	
70	F		102	f	
71	G		103	g	
72	H		104	h	
73	I		105	i	
74	J		106	j	
75	K		107	k	
76	L		108	l	
77	M		109	m	
78	N		110	n	
79	O		111	o	
80	P		112	p	
81	Q		113	q	
82	R		114	r	
83	S		115	s	
84	T		116	t	
85	U		117	u	
86	V		118	v	
87	W		119	w	
88	X		120	x	
89	Y		121	y	
90	Z		122	z	

First of all we convert each character of "Phone" into ASCII code and then convert into binary.

Character	Code	Binary
P	80	1010000
h	104	1101000
o	111	1101111
n	110	1101110
e	101	1100101

Memory representation of word "Phone" starting from address 7003 is as follows:

7003	7004	7005	7006	7007
0 1 0 1 0 0 0 0	0 1 1 0 1 0 0 0	0 1 1 0 1 1 1 1	0 1 1 0 1 1 1 0	0 1 1 0 0 1 0 1

4. Differentiate between temporary and permanent storage. **(K.B+U.B)**

Ans: **<u>DIFFERENTIATE</u>**

The difference between temporary and permanent storage is as follows:

Temporary Storage	Permanent Storage
Definition	
A device which stores data temporarily is called temporary storage. A temporarily storage means where an application loads its data during processing.	A device which stores data permanently is called permanent storage. A permanent storage means the place where data is stored for long or short term.
Example	
RAM is an example of temporary storage.	Hard drives, flash drives and memory cards are examples of permanent storage.
Speed	
It has high accessing speed.	It has low accessing speed.
Another name	
It is called primary memory.	It is called secondary memory.

5. Write the truth table for X AND Y where
X = It is sunny
Y = Today is Monday **(U.B+A.B)**

Ans: **<u>TRUTH TABLE FOR AND OPERATOR</u>**

The truth table for X AND Y is given below. The first two columns are showing all the possible combinations of truth values of proposition X and Y, the third column is showing the resultant truth value of X AND Y.

X = It is sunny
Y = Today is Monday
X AND Y = It is sunny and Today is Monday

If both X and Y are True then the X and Y is also True, it means "It is sunny on Monday". This situation is shown on Row 1 of the following table.

Suppose it is sunny but not on Sunday. Then X is True and Y is False due to which X AND Y is also False (row 2 of the following table).

In row 3 of the following table, X is False and Y is true then value of X AND Y is False.

In the last row both X and Y are False, which means "It is neither raining nor Sunday". So, the proposition "It is sunny and today is Monday" is false (row 4 of Table).

X	Y	X AND Y
T	T	T
T	F	F
F	T	F
F	F	F

1.3 Fill in the Blanks

1. Temporary memory is _______ and permanent memory is __________. **(K.B+U.B)**

2. Data to a processor is provided through ________. **(K.B+U.B)**

3. At least ___________ byte is required to store any piece of information in a computer's memory. **(K.B+U.B)**

4. _________ is used to assemble more than one propositions into one proposition. **(U.B)**

5. In primary and secondary storage, data is stored in the form of __________. **(K.B+U.B)**

6. According to ___________ law there is change in results if priority of expressions is changed. **(K.B+U.B)**

ANSWERS

1	**Volatile, non-volatile**	2	**RAM**	3	**One**	4	**Compound proposition**	5	**Bytes**
6	**Associative**								

Q.4 Perform the following conversations.

1. (ABCD)$_{16}$ to binary. **(A.B)**

Ans: **CONVERSION**

In this number, there are four hexadecimal digits. Binary of each digit is given as:

i. For A, the binary value is 1010
ii. For B, the binary value is 1011
iii. For C, the binary value is 1100
iv. For D, the binary value is 1101

By combining all the binary values, we get 1010 1011 1100 1101

So, (ABCD)$_{16}$ = (1010101111001101)$_2$

Hexadecimal	Binary
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001
A	1010
B	1011
C	1100
D	1101
E	1110
F	1111

2. (0010110010001101001)$_2$ to hexadecimal. **(A.B)**

Ans: **CONVERSION**

The five-digit binary groups in this binary number are given below where each group has four binary digits.

While making groups from right to left, if the left group has less than 4 binary digits then we simply add 0s on the left. For example, 0010110010001101001 has 5 groups and by adding one 0 on the left it becomes 0001 0110 0100 0110 1001.

i. For 0001, the hexadecimal is 1

ii. For 0110, the hexadecimal is 6
iii. For 0100, the hexadecimal is 4
iv. For 0110, the hexadecimal is 6
v. For 1001, the hexadecimal is 9
So, $(0010110010001101001)_2 = (16469)_{16}$

Hexadecimal	Binary
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001
A	1010
B	1011
C	1100
D	1101
E	1110
F	1111

ACTIVITY QUESTIONS

Activity 2.8 (A.B)

Teacher will display a chart where alphabets and their codes are written. Class is divided into two groups and each group writes at least 5 names in binary format. The famous names are selected from Pakistan Independence movement e.g., "Molana Muhammad Ali Johar". Both groups exchange their data and produces original names. The group which deciphers the code to actual names in less time will win.

SOLUTION

Code	Character	Description	Code	Character	Description
32	SP	Space			
65	A		97	a	
66	B		98	b	
67	C		99	c	
68	D		100	d	
69	E		101	e	
70	F		102	f	
71	G		103	g	
72	H		104	h	
73	I		105	i	
74	J		106	j	
75	K		107	k	
76	L		108	l	

77	M		109	m	
78	N		110	n	
79	O		111	o	
80	P		112	p	
81	Q		113	q	
82	R		114	r	
83	S		115	s	
84	T		116	t	
85	U		117	u	
86	V		118	v	
87	W		119	w	
88	X		120	x	
89	Y		121	y	
90	Z		122	z	

Convert "Molana Muhammad Ali Johar" into ASCII code and then convert into binary.

Character	Code	Binary
M	77	01001101
o	111	01101111
l	108	01101100
a	97	01100001
n	110	01101110
a	97	01100001
Space	32	00100000
M	77	01001101
u	117	01110101
h	104	01101000
a	97	01100001
m	109	01101101
m	109	01101101
a	97	01100001
d	100	01100100
Space	32	00100000
A	65	01000001
l	108	01101100
i	105	01101001
Space	32	00100000
J	74	01001010
o	111	01101111
h	104	01101000
a	97	01100001
r	114	01110010

ANSWERS

2.1 INTRODUCTION TO NUMBER SYSTEMS

1	A	2	B	3	A	4	B	5	B
6	C	7	C	8	B	9	B	10	C
11	C	12	D	13	D	14	A	15	C
16	D	17	B						

2.2 NUMBER SYSTEM CONVERSION

1	A	2	C	3	D	4	A

2.3 MEMORY AND DATA STORAGE

1	A	2	A	3	A	4	B	5	B
6	C								

2.4 MEASUREMENT OF SIZE OF COMPUTER MEMORY

1	C	2	C	3	C	4	D	5	A

2.5 BOOLEAN ALGEBRA

1	A	2	C	3	A	4	C	5	D
6	A	7	B	8	C	9	B	10	B
11	A	12	C	13	A	14	B	15	B
16	A	17	B	18	D	19	B	20	B
21	B	22	B	23	B	24	D	25	B
26	B	27	C	28	C	29	B	30	A