ASSIGNMENT #1

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Question #1

The stated number 490.286468506 is represented as a positive decimal number, you are required to represent it as a binary floating-point number having 1 sign bit, 8-bit exponent, and 23 bits mantissa.

Solution

First we convert 490 into binary number using repeated division method,

Division	Quotient	Remainder
490 ÷ 2	245	0
245 ÷ 2	122	1
122 ÷ 2	61	0
61 ÷ 2	30	1
30 ÷ 2	15	0
15 ÷ 2	7	1
7 ÷ 2	3	1
3 ÷ 2	1	1
1 ÷ 2	0	1

Here, 490 is equivalent to **111101010** in binary numbers.

Now, we convert 0.286468506 into binary fractional numbers,

Limit	Multiplication	Product	Constant
1	0.286468506 × 2	0.572937012	0
2	0.572937012 × 2	0.145874024	1
3	0.145874024 × 2	0.291748048	0
4	0.291748048 × 2	0.583496096	0
5	0.583496096 × 2	0.166992192	1
6	0.166992192 × 2	0.333984384	0
7	0.333984384 × 2	0.667968768	0
8	0.667968768 × 2	0.335937536	1
9	0.335937536 × 2	0.671875072	0
10	0.671875072 × 2	0.343750144	1
11	0.343750144 × 2	0.687500288	0
12	0.687500288 × 2	0.375000576	1
13	0.375000576 × 2	0.750001152	0
14	0.750001152 × 2	0.500002304	1
15	0.500002304 × 2	0.000004608	1
16	0.000004608 × 2	0.000009216	0
17	0.000009216 × 2	0.000018432	0
18	0.000018432 × 2	0.000036864	0
19	0.000036864 × 2	0.000073728	0

20	0.000073728 × 2	0.000147456	0
21	0.000147456 × 2	0.000294912	0
22	0.000294912 × 2	0.000589824	0
23	0.000589824 × 2	0.001179648	0
24	0.001179648 × 2	0.002359296	0

We had reached the limit of **23 bits** for mantissa, so we have enough precision to full stop.

So, the decimal fraction 0.286468506 is equivalent to **0.01001001010101100000000**

Therefore, by combining both terms as 490.286468506 we get,

111101010.01001001010101100000000

Now, normalizing the exponent by shifting the decimal point to left hand side.

1.11101010010010010101011000000000 x 2^8

Now, we convert exponent into binary number.

Exponent $= 8 + 127 = 135$

Division	Quotient	Remainder
135 ÷ 2	67	1
67 ÷ 2	33	1
33 ÷ 2	16	1
16 ÷ 2	8	0
8 ÷ 2	4	0
4 ÷ 2	2	0
2 ÷ 2	1	0
1 ÷ 2	0	1

So, the exponent value 135 is equivalent to **10000111** in binary numbers.

As we know, if the number is positive so we put **0** (false) in the sign-bit place.

Finally, we get the answer, **0 10000111 11101010010010010101011**

Answer

Sign		Exponent									Mantissa									
0		1	0	0	0	0	1	1	1		1	1	1	0	1	0	1	0	0	…

…	1	0	0	1	0	0	1	0	1	0	1	0	1	1

Question #2

Simplify the stated 5 variable boolean expression using **karnaugh map**.

$F(A, B, C, D, E) = (1, 2, 3, 14, 20, 21, 22, 23, 27, 28)$

With the following don't care conditions:

$F(A, B, C, D, E) = (6, 7, 11, 12, 16, 26, 30)$

Solution

From the above question, we get the required data as,

Minterm $= (1, 2, 3, 14, 20, 21, 22, 23, 27, 28)$
Don't care $= (6, 7, 11, 12, 16, 26, 30)$
Variables $= (A, B, C, D, E)$

A,B\C,D,E	000	001	011	010	110	111	101	100
00	00	11	13	12	X6	X7	05	04
01	08	09	X11	010	114	015	013	X12
11	024	025	127	X26	X30	031	029	128
10	X16	017	019	018	122	123	121	120

Now, making groups accordingly as **karnaugh map** expressions:

A,B\C,D,E	000	001	011	010	110	111	101	100
00	00	11	13	12	X6	X7	05	04
01	08	09	X11	010	114	015	013	X12
11	024	025	127	X26	X30	031	029	128
10	X16	017	019	018	122	123	121	120

Answers

Group 1:
Cell Grouping 2
Positions 11, 27
Simplified Expression BC'DE

Group 2:
Cell Grouping 2
Positions 1, 3
Simplified Expression A'B'C'E

Group 3:
Cell Grouping 4
Positions 12, 14, 28, 30
Simplified Expression BCE'

Group 4:

Cell Grouping	4
Positions	20, 21, 22, 23
Simplified Expression	AB'C

Group 5:

Cell Grouping	4
Positions	2, 3, 6, 7
Simplified Expression	A'B'D

So, we get our final expression as,

BC'DE + A'B'C'E + BCE' + AB'C + A'B'D