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Date: ___ / ___ / 20___

Name:

Saad Ahmad.

Roll no:

20P-0051

Section:

BS (CS) - 2D

Subject:

(S) = AF8.288A8

Digital logics and Designs (DLD).

Question # 1

Decimal	Signed Magnitude Form	1's Complement	2's Complement
7	0111	1100 + 1011 + 0110 + 0011	1101 + 1011 + 0110 + 0011
6	0110	1100 + 1011 + 0110 + 0011	1101 + 1011 + 0110 + 0011
5	0101	1100 + 1011 + 0110 + 0011	1101 + 1011 + 0110 + 0011
4	0100	1100 + 1011 + 0110 + 0011	1101 + 1011 + 0110 + 0011
3	0011	1100 + 1011 + 0110 + 0011	1101 + 1011 + 0110 + 0011
2	0010	1100 + 1011 + 0110 + 0011	1101 + 1011 + 0110 + 0011
1	0001	1100 + 1011 + 0110 + 0011	1101 + 1011 + 0110 + 0011
0	0000	1100 + 1011 + 0110 + 0011	1101 + 1011 + 0110 + 0011
-0	1000	1100 + 1011 + 0110 + 0011	1101 + 1011 + 0110 + 0011
-1	1001	1100 + 1011 + 0110 + 0011	1101 + 1011 + 0110 + 0011
-2	1010	1100 + 1011 + 0110 + 0011	1101 + 1011 + 0110 + 0011
-3	1011	1100 + 1011 + 0110 + 0011	1101 + 1011 + 0110 + 0011

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-4	1100	1011	1100
-5	1101	1010	1011
-6	1110	1001	1010
-7	1111	1000	1001
-8	-	-	1000

Question #3.

$$(86235 \cdot 876)_{\frac{10}{2}} = (?)$$

By Sum of weight:

86235.876

86235						$2^0 = 1 \checkmark$
= 65536 + 20699						$2^1 = 2 \checkmark$
= 65536 + 16384 + 4315						$2^2 = 4$
= 65536 + 16384 + 4096 + 219						$2^3 = 8 \checkmark$
= 65536 + 16384 + 4096 + 128 + 91						$2^4 = 16 \checkmark$
= 65536 + 16384 + 4096 + 128 + 64 + 27						$2^5 = 32$
= 65536 + 16384 + 4096 + 128 + 64 + 16 + 11						$2^6 = 64 \checkmark$
= 65536 + 16384 + 4096 + 128 + 64 + 16 + 8 + 3						$2^7 = 128 \checkmark$
= 65536 + 16384 + 4096 + 128 + 64 + 16 + 8 + 2 + 1						$2^8 = 256$
$2^{16} \quad 2^{14} \quad 2^{12} \quad 2^7 \quad 2^6 \quad 2^{10} = 1024$						$2^9 = 512$
= 65536 + 16384 + 4096 + 128 + 64 + 16 + 8 + 2 + 1						$2^{11} = 2048$
$2^4 \quad 2^3 \quad 2^1 \quad 2^0 \quad 1 \quad 1 \quad 1$						$2^{12} = 4096 \checkmark$
$16 + 8 + 2 + 1 \quad 0 \quad 1 \quad 1$						$2^{13} = 8192$
$0 \quad 1 \quad 1$						$2^{14} = 16384 \checkmark$
10101000011011011						$2^{15} = 32768$
						$2^{16} = 65536 \checkmark$

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0.876

$$= 0.5 + 0.376$$

$$= 0.5 + 0.25 + 0.126$$

$$= 0.5 + 0.25 + 0.125 + 0.001$$

$$2^{-1} = 0.5 \checkmark$$

$$2^{-2} = 0.25 \checkmark$$

$$2^{-3} = 0.125 \checkmark$$

$$2^{-4} = 0.0625$$

$$2^{-5} = 0.03125$$

$$- 2^{-1} \quad 2^{-2} \quad 2^{-3} \quad 0$$

$$= 0.5 + 0.25 + 0.125 + 0.001$$

0.11100

So,

$$(10101000011011011.11100)_2 = (86235.876)_{10}$$

~~XXXXXXXXXX~~ - 86235 = 0.876

~~XXXXXX~~

By Repeated division and multiplication method:

86235.876.

		(10101000011011011.11100)
2	<u>86235</u>	<u>43117</u>
2	<u>43117 - 1</u>	<u>86234</u>
2	<u>21558 - 1</u>	<u>21558</u>
2	<u>10779 - 0</u>	<u>2143117</u>
2	<u>5389 - 1</u>	<u>43116</u>
2	<u>2694 - 1</u>	<u>10779</u>
2	<u>1347 - 0</u>	<u>21558</u>
2	<u>673 - 1</u>	<u>21558</u>
	<u>336 - 1</u>	<u>0</u>

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	2 336	$2 \sqrt{10776} + 2.0$
	2 168 - 0 ↑	$2 \sqrt{5388} + 2.0$
	2 84 - 0	$2 \sqrt{2694} + 2.0$
	2 42 - 0	$2 \sqrt{1347} + 2.0$
	2 21 - 0	$2 \sqrt{672} + 2.0$
	2 10 - 1	$2 \sqrt{336} + 2.0$
	2 5 - 0	$2 \sqrt{168} + 2.0$
	2 2 - 1.0	$2 \sqrt{84} + 2.0$
	1 - 0	$2 \sqrt{42} + 2.0$
	→	$2 \sqrt{21} + 2.0$
		$2 \sqrt{10.5} + 2.0$
		$2 \sqrt{5.25} + 2.0$
		$2 \sqrt{2.625} + 2.0$
		$2 \sqrt{1.3125} + 2.0$
		$2 \sqrt{0.65625} + 2.0$
		$2 \sqrt{0.328125} + 2.0$
		$2 \sqrt{0.1640625} + 2.0$
		$2 \sqrt{0.08203125} + 2.0$
		$2 \sqrt{0.041015625} + 2.0$
		$2 \sqrt{0.0205078125} + 2.0$
		$2 \sqrt{0.01025390625} + 2.0$
		$2 \sqrt{0.005127953125} + 2.0$
		$2 \sqrt{0.0025639765625} + 2.0$
		$2 \sqrt{0.00128198828125} + 2.0$
		$2 \sqrt{0.000640994140625} + 2.0$
		$2 \sqrt{0.0003204970703125} + 2.0$
		$2 \sqrt{0.00016024853515625} + 2.0$
		$2 \sqrt{0.000080124267578125} + 2.0$
		$2 \sqrt{0.0000400621337890625} + 2.0$
		$2 \sqrt{0.00002003106689453125} + 2.0$
		$2 \sqrt{0.000010015533447265625} + 2.0$
		$2 \sqrt{0.0000050077667236328125} + 2.0$
		$2 \sqrt{0.00000250388336181640625} + 2.0$
		$2 \sqrt{0.000001251941680908203125} + 2.0$
		$2 \sqrt{0.0000006259708404751015625} + 2.0$
		$2 \sqrt{0.00000031254842023750078125} + 2.0$
		$2 \sqrt{0.000000156274210118750390625} + 2.0$
		$2 \sqrt{0.0000000781371050593751953125} + 2.0$
		$2 \sqrt{0.0000000390685525296875975625} + 2.0$
		$2 \sqrt{0.00000001953427626484379878125} + 2.0$
		$2 \sqrt{0.000000009767138132421899390625} + 2.0$
		$2 \sqrt{0.0000000048835690662109496953125} + 2.0$
		$2 \sqrt{0.00000000244178453310547484765625} + 2.0$
		$2 \sqrt{0.000000001220892266552737423828125} + 2.0$
		$2 \sqrt{0.0000000006104461332763687119140625} + 2.0$
		$2 \sqrt{0.00000000030522306663818435595703125} + 2.0$
		$2 \sqrt{0.000000000152611533319092177978515625} + 2.0$
		$2 \sqrt{0.00000000007630576665954608898925625} + 2.0$
		$2 \sqrt{0.000000000038152883329773044494878125} + 2.0$
		$2 \sqrt{0.00000000001907644166488652224739375} + 2.0$
		$2 \sqrt{0.000000000009538220833244261123696875} + 2.0$
		$2 \sqrt{0.0000000000047691104166221305618484375} + 2.0$
		$2 \sqrt{0.00000000000238455520831106528024221875} + 2.0$
		$2 \sqrt{0.0000000000012022776041555326401210875} + 2.0$
		$2 \sqrt{0.00000000000060113880207776632006054375} + 2.0$
		$2 \sqrt{0.000000000000300569401038883160030271875} + 2.0$
		$2 \sqrt{0.0000000000001502847005194415800151359375} + 2.0$
		$2 \sqrt{0.0000000000000751423502597207900075796875} + 2.0$
		$2 \sqrt{0.000000000000037571175129860395003889375} + 2.0$
		$2 \sqrt{0.0000000000000187855875649301975019446875} + 2.0$
		$2 \sqrt{0.00000000000000939279378246505000097234375} + 2.0$
		$2 \sqrt{0.000000000000004696396891232525000486171875} + 2.0$
		$2 \sqrt{0.0000000000000023481984456162625002430859375} + 2.0$
		$2 \sqrt{0.00000000000000117409922280813125012154296875} + 2.0$
		$2 \sqrt{0.0000000000000005870496114040656250060771484375} + 2.0$
		$2 \sqrt{0.00000000000000029352480570203281250303857431875} + 2.0$
		$2 \sqrt{0.00000000000000014676240285101640625015172871484375} + 2.0$
		$2 \sqrt{0.00000000000000007338120142555020312500758643875} + 2.0$
		$2 \sqrt{0.0000000000000000366906007127751015625003791875} + 2.0$
		$2 \sqrt{0.00000000000000001834530035638755078125001895875} + 2.0$
		$2 \sqrt{0.000000000000000009172650178193775390625000949375} + 2.0$
		$2 \sqrt{0.0000000000000000045863250890968875937500047471875} + 2.0$
		$2 \sqrt{0.00000000000000000229316254454844379687500023734375} + 2.0$
		$2 \sqrt{0.0000000000000000011465812722742218984375000118671875} + 2.0$
		$2 \sqrt{0.0000000000000000005732906361371109496875000059334375} + 2.0$
		$2 \sqrt{0.00000000000000000028664531806855547484375000296671875} + 2.0$
		$2 \sqrt{0.000000000000000000143322659034277737437500001483375} + 2.0$
		$2 \sqrt{0.0000000000000000000716613295017388687437500007416875} + 2.0$
		$2 \sqrt{0.00000000000000000003583066475086943437437500037084375} + 2.0$
		$2 \sqrt{0.000000000000000000017915332375434717187437500185421875} + 2.0$
		$2 \sqrt{0.00000000000000000000895766618772185859374375000927109375} + 2.0$
		$2 \sqrt{0.00000000000000000000447883309386092929687437500463555375} + 2.0$
		$2 \sqrt{0.000000000000000000002239416546930464648874375002317776875} + 2.0$
		$2 \sqrt{0.00000000000000000000111970827346523223443743750011588875} + 2.0$
		$2 \sqrt{0.000000000000000000000559854136732616117218743750005794375} + 2.0$
		$2 \sqrt{0.0000000000000000000002799270683663080586087437500028971875} + 2.0$
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		$2 \sqrt{0.000000000000000000000069981767091577014652187437500072428125} + 2.0$
		$2 \sqrt{0.00000000000000000000003499088354578850732608743750003621484375} + 2.0$
		$2 \sqrt{0.00000000000000000000001749544177289425366304374375000181074375} + 2.0$
		$2 \sqrt{0.0000000000000000000000087477208864471278315218743750000905375} + 2.0$
		$2 \sqrt{0.00000000000000000000000437386044322356391576087437500004526875} + 2.0$
		$2 \sqrt{0.000000000000000000000002186930221611781958880874375000022634375} + 2.0$
		$2 \sqrt{0.0000000000000000000000010934651108058909794408743750000113175} + 2.0$
		$2 \sqrt{0.000000000000000000000000546732555402945299720437500000565875} + 2.0$
		$2 \sqrt{0.00000000000000000000000027336627770147264986021875000002829375} + 2.0$
		$2 \sqrt{0.000000000000000000000000136683138850736324930108750000014146875} + 2.0$
		$2 \sqrt{0.000000000000000000000000068341569425368162465054375000000707375} + 2.0$
		$2 \sqrt{0.0000000000000000000000000341707847126840812325287500000003536875} + 2.0$
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		$2 \sqrt{0.0000000000000000000000000001334796277839221973030574375000001381591796875} + 2.0$
		$2 \sqrt{0.000000000000000000000000000066739813891961098651528750000000690795859375} + 2.0$
		$2 \sqrt{0.0000000000000000000000000000333699069459805493257437500000003453979296875} + 2.0$
		$2 \sqrt{0.00000000000000000000000000001668495347299027466287437500000017269896484375} + 2.0$
		$2 \sqrt{0.000000000000000000000000000008342476736495137331437500000000086349482421875} + 2.0$
		$2 \sqrt{0.0000000000000000000000000000041712383682475686657187500000000431747412109375} + 2.0$
		$2 \sqrt{0.0000000000000000000000000000020856191841237833328743750000000215873705546875} + 2.0$
		$2 \sqrt{0.0000000000000000000000000000010428095920618916644375000000001079368527859375} + 2.0$
		$2 \sqrt{0.00000000000000000000000000000052140479603094508221875000000005396842639109375} + 2.0$
		$2 \sqrt{0.000000000000000000000000000000260702398015472541109375000000026984213195546875} + 2.0$
		$2 \sqrt{0.00000000000000000000000000000013035119900773627555743750000001349210659775} + 2.0$
		$2 \sqrt{0.00000000000000000000000000000006517559950386813777875000000006746053298859375} + 2.0$
		$2 \sqrt{0.0000000000000000000000000000000325877997519340688893750000000337302664945546875} + 2.0$
		$2 \sqrt{0.00000000000000000000000000000001629389987596703444487500000001686513324725} + 2.0$
		$2 \sqrt{0.00000000000000000000000000000000814694993798351722237500000000843256662361875} + 2.0$
		$2 \sqrt{0.0000000000000000000000000000000040734749689917586111875000000042162833118296875} + 2.0$
		$2 \sqrt{0.000000000000000000000000000000002036737484495879305593750000002108141655945546875} + 2.0$
		$2 \sqrt{0.0000000000000000000000000000000010183687422479396529743750000010540708277275} + 2.0$
		$2 \sqrt{0.0000000000000000000000000000000005091843721239698264875000000052703541388859375} + 2.0$
		$2 \sqrt{0.000000000000000000000000000000000254592186061984913243750000002635177069445546875} + 2.0$
		$2 \sqrt{0.0000000000000000000000000000000001272960930309924562237500000013175885347225} + 2.0$
		$2 \sqrt{0.00000000000000000000000000000000006364804651549622811875000000658794267361875} + 2.0$
		$2 \sqrt{0.00000000000000000000000000000000003182402325774811405$

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412

$$0.390625 \times 2 = 0.78125 - 0$$

$$\begin{array}{r} 2 \\ | \\ 412 \end{array}$$

$$\begin{array}{r} 2 \\ | \\ 206 \end{array}$$

$$\begin{array}{r} 2 \\ | \\ 103 \end{array}$$

$$\begin{array}{r} 2 \\ | \\ 51 \end{array}$$

$$\begin{array}{r} 2 \\ | \\ 25 \end{array}$$

$$\begin{array}{r} 2 \\ | \\ 12 \end{array}$$

$$\begin{array}{r} 2 \\ | \\ 6 \end{array}$$

$$\begin{array}{r} 2 \\ | \\ 3 \end{array}$$

$$\begin{array}{r} 1 \\ | \\ 1 \end{array}$$

206

412

X

$$\begin{array}{r} 103 \\ \times 2 \\ \hline 206 \end{array}$$

$$\begin{array}{r} 206 \\ \times 2 \\ \hline 412 \end{array}$$

$$\begin{array}{r} 25 \\ \times 2 \\ \hline 50 \end{array}$$

$$\begin{array}{r} 50 \\ \times 2 \\ \hline 100 \end{array}$$

$$\begin{array}{r} 100 \\ \times 2 \\ \hline 200 \end{array}$$

$$\begin{array}{r} 200 \\ \times 2 \\ \hline 400 \end{array}$$

0.390625

$$0.390625 \times 2 = 0.781250 - 0$$

$$0.78125 \times 2 = 1.56250 - 1$$

$$0.5625 \times 2 = 1.1250 - 1$$

$$0.125 \times 2 = 0.250 - 0$$

$$0.25 \times 2 = 0.5 - 0$$

$$0.5 \times 2 = 1.00 - 1$$

$$(S) = (101.101100)$$

$$(412)_{10} = (11.001100)_2$$

$$(0.390625)_{10} = (011001)_2$$

$$= C_0x^0 + C_1x^1 + C_2x^2 + C_3x^3 + C_4x^4 + C_5x^5 + C_6x^6 + C_7x^7$$

$$11001100 \cdot 011001$$

As it is a negative number so sign-bit (S) is 1

Now we will write (11001100 · 011001) in scientific form, so $0.2 + 1.0 \times 2^{-1} + 0.1 \times 2^{-2} + 0.0 \times 2^{-3} + 0.0 \times 2^{-4} + 0.1 \times 2^{-5} + 0.0 \times 2^{-6} + 1.0 \times 2^{-7}$

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$$110011100.011001 = 1.\underline{10011100011001} \times 2^8$$

Mantissa

As the power is +8 so we will add 8 with 127, so.

$$127 + 8 = 135 = (\underline{10000111})_2$$

Exponent.

Now,

1	10000111	10011000110010000000000
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0 - 0.25185. Mantissa.

Sign bit

Exponent

Question #2

$$(11011101.1011)_2 = (?)$$

By sum of weights:

$$\begin{aligned} & 1 \times 2^8 + 1 \times 2^7 + 0 \times 2^6 + 1 \times 2^5 + 1 \times 2^4 + 1 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0 + 1 \times 2^{-1} + \\ & 0 \times 2^{-2} + 1 \times 2^{-3} + 1 \times 2^{-4} \end{aligned}$$

$$\begin{aligned} & 1 \times 256 + 1 \times 128 + 0 + 1 \times 32 + 1 \times 16 + 1 \times 8 + 1 \times 4 + 0 + 1 + 1 \times 0.5 + \\ & 0 + 1 \times 0.125 + 0.0625 \times 1 \end{aligned}$$

$$256 + 128 + 32 + 16 + 8 + 4 + 1 + 0.5 + 0.125 + 0.0625$$

$$445 + 0.6875$$

$$445 - 0.6875$$

(Q) Convert binary

0.6875_{10}

256_{10}

128_{10}

64_{10}

32_{10}

16_{10}

8_{10}

4_{10}

2_{10}

1_{10}

0.1111_{10}

0.5000_{10}

0.1250_{10}

0.0625_{10}

0.03125_{10}

0.015625_{10}

0.0078125_{10}

0.00390625_{10}

0.001953125_{10}

0.0009765625_{10}

0.00048828125_{10}

0.000244140625_{10}

0.0001220703125_{10}

0.00006103515625_{10}

0.000030517578125_{10}

0.0000152587890625_{10}

0.00000762939453125_{10}

$0.000003814697265625_{10}$

$0.0000019073486328125_{10}$

$0.00000095367431640625_{10}$

$0.000000476837158203125_{10}$

$0.0000002384185791015625_{10}$

$0.00000011920928955078125_{10}$

$0.000000059604644775390625_{10}$

$0.0000000298023223876953125_{10}$

$0.00000001490116119384765625_{10}$

$0.000000007450580596923828125_{10}$

$0.0000000037252902984619145625_{10}$

$0.00000000186264514923095728125_{10}$

$0.000000000931322574615478640625_{10}$

$0.0000000004656612873077393203125_{10}$

$0.00000000023283064365386966015625_{10}$

$0.000000000116415321826934830078125_{10}$

$0.000000000058207660913467415003125_{10}$

$0.0000000000291038304567337075015625_{10}$

$0.00000000001455241522836685375078125_{10}$

$0.000000000007276207614183347875390625_{10}$

$0.0000000000036381038070916739376953125_{10}$

$0.00000000000181905190354583696884765625_{10}$

$0.000000000000909525951772918484423828125_{10}$

$0.00000000000045476297588645924221190625_{10}$

$0.00000000000022738148794322962110593125_{10}$

$0.000000000000113690743971614810552965625_{10}$

$0.0000000000000568453719858074052764828125_{10}$

$0.00000000000002842268599290370263824140625_{10}$

$0.000000000000014211342996451851319120703125_{10}$

$0.0000000000000071056714982259256595603515625_{10}$

$0.00000000000000355283574911296282978017578125_{10}$

$0.000000000000001776417874556493414890087890625_{10}$

$0.0000000000000008882089372782472074450439453125_{10}$

$0.000000000000000444104468639123603722221972703125_{10}$

$0.0000000000000002220522343195618018611109888453125_{10}$

$0.000000000000000111026117159780900930555494422703125_{10}$

$0.0000000000000000555130585798904504677777772113453125_{10}$

$0.000000000000000027756529289945225233888888605672703125_{10}$

$0.000000000000000013878264644972612617444444302813453125_{10}$

$0.00000000000000000693913232248630630872222221515172703125_{10}$

$0.00000000000000000346956616124315315436111110757853453125_{10}$

$0.0000000000000000017347830806215765772055555538242672703125_{10}$

$0.000000000000000000867391540310788288602777777191213453125_{10}$

$0.00000000000000000043369577015539414430138888888555672703125_{10}$

$0.00000000000000000021684788507769707215069444444277853125_{10}$

$0.0000000000000000001084239425388485360753477777713892703125_{10}$

$0.000000000000000000054211971269424268037688888886949672703125_{10}$

$0.00000000000000000002710598563471213401894444444347483453125_{10}$

$0.0000000000000000000135529928173560670094722222217374172703125_{10}$

$0.00000000000000000000677649640867803350496111111086850853125_{10}$

$0.0000000000000000000033882482043390167524805555554342542703125_{10}$

$0.000000000000000000001694124102169508326240277777721772172703125_{10}$

$0.0000000000000000000008470620510847504131201388888889010853125_{10}$

$0.00000000000000000000042353102554237520656006944444444444444444453125_{10}$

$0.0000000000000000000002117655127711876032800347777777777777777772703125_{10}$

$0.00000000000000000000010588275638559380164001738888888888888888813453125_{10}$

$0.0000000000000000000000529413781927797008200086944444444444444444672703125_{10}$

$0.00000000000000000000002647068909639980041000434777777777777777734172703125_{10}$

$0.000000000000000000000013235344548199900205002173888888888888888170853125_{10}$

$0.0000000000000000000000066176722740999501025010869444444444444440854172703125_{10}$

$0.00000000000000000000000330883613704997505125054347777777777777704270853125_{10}$

$0.00000000000000000000000165441806852498752562527173888888888888802134172703125_{10}$

$0.000000000000000000000000827209034262499378125131368888888888888011670853125_{10}$

$0.000000000000000000000000413604517131249689062565684444444444444005854172703125_{10}$

$0.0000000000000000000000002068022585656248445312532822222222222220027770853125_{10}$

$0.00000000000000000000000010340112928281242226562516444444444444400138853125_{10}$

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$0.0000000000000000000000000258502822570703105656254066666666666660003470853125_{10}$

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$0.00000000000000000000000000000019722200208360520597777777777700000000026479853125_{10}$

$0.0000000000000000000000000000000986110010418027529888888888880000000001323994172703125_{10}$

$0.0000000000000000000000000000000493055005209013764944444444$

(8)

Date: ___/___/20___

$$(-1)(1.110001)(2^{55})$$

Now calculating mantissa i.e.

$$\Rightarrow \text{mantissa} = 110001$$

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

$$= 0.5 + 0.25 + 0 + 0 + 0 + 0.015625$$

$$= 0.765625$$

So now put it in general formula i.e. eq. ①

$$(-1)'(1.765625)(2^{55}) - ②$$

By solving the eq 2 we get.

$$-6.361334474 \times 10^{16}$$