2^{31} .... 2^7 2^6 2^5 2^4 2^3 2^2 2^1 2^0

20 → 0 ------------ 0 0 0 1 0 1 0 0

1's comp → 1 ------------ 1 1 1 0 1 0 1 1

bin(1) → + 0 ------------ 0 0 0 0 0 0 0 1

(-20) → 1 ------------ 1 1 1 0 1 1 0 0

$<<3$ → 1 ------ 1 1 1 0 1 1 0 0 0 0 0

↑ binary of <u>(-160)</u>

					512	128	64	32	16	8	4	2	1
	2^{31}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
	0 ---	0	0	0	0	0	0	0	0	0	0	0	0
160 →	0 ---	0	0	0	0	1	0	1	0	0	0	0	0

$$\begin{array}{r} 160 \\ -\,128 \\ \hline 32 \end{array} \qquad \begin{array}{r} 32 \\ -32 \\ \hline 0 \end{array}$$

160 → 0 ------------ 0 0 1 0 1 0 0 0 0 0

1's comp 1 ------------ 1 1 0 1 0 1 1 1 1 1

\+ 0 ------------ 0 0 0 0 0 0 0 0 0 1

1 1 1 1 1

<u>(-160)</u> → 1 ------------ 1 1 0 1 1 0 0 0 0 0

* Program 1 - Solve Following shifting operation on paper and share that with your leader.

① num = 88 result = num << 4;

			128	64	32	16	8	4	2	1
	2^{31}		2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
~~88~~ →	0	-------	0	0	0	0	0	0	0	0
88 →	0	-------	0	1	0	1	1	0	0	0

$$\begin{array}{r} 88 \\ -64 \\ \hline 24 \end{array} \quad \begin{array}{r} 24 \\ -16 \\ \hline 8 \end{array} \quad \begin{array}{r} 8 \\ -8 \\ \hline 0 \end{array}$$

it is a left shift bitwise operator.
Now shift 88 by 4 bits to the left.

	2^{31}													
88 →	0	-------	0	0	0	0	0	1	0	1	1	0	0	0
	2^{31}													
<<4 →	0	-------	0	1	0	1	1	0	0	0	0	0	0	0
			2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

1024 + 256 + 128 = <u>1408</u> (Ans)

② num = -20 result = num << 3;

			128	64	32	16	8	4	2	1
	2^{31}		2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
	0	-------	0	0	0	0	0	0	0	0
20 →	0	-------	0	0	0	1	0	1	0	0

$$\begin{array}{r} 20 \\ -16 \\ \hline 4 \end{array} \quad \begin{array}{r} 4 \\ -4 \\ \hline 0 \end{array}$$

But (-20) internally stored as a 2's complement of (20) and then shift that binary no by 3 bits to the left.

2's complement (20)
= 1's complement (20)
\+ binary (1)