1. Add the following

$1100111_2 + 1001111_2 = 10110110_2$

$$
\begin{array}{r}
1100111 \\
+\ 1001111 \\
\hline
10110110
\end{array}
$$

$234_8 + 654_8 = 1110_8$

Octal to Decimal

$234_8 = (2\times8^2)+(3\times8^1)+(4\times8^0)$

$128+24+4$

$234_8 = 156_{10}$

$654_8 = (6\times8^2)+(5\times8^1)+(4\times8^0)$

$384+40+4$

$654_8 = 428_{10}$

Decimal to Binary

$156_{10} = 10011100_2$

2	156	r. 0
2	78	r. 0
2	39	r. 1
2	19	r. 1
2	9	r. 1
2	4	r. 0
2	2	r. 0
2	1	r. 1
	0	

$428_{10} = 110101100_2$

2	428	r. 0
2	214	r. 0
2	107	r. 1
2	53	r. 1
2	26	r. 0
2	13	r. 1
2	6	r. 0
2	3	r. 1
2	1	r. 1
	0	

$$
\begin{array}{r}
110101100 \\
+\ 10011100 \\
\hline
1001001000
\end{array}
$$

Binary to Decimal

$1001001000_2 = (1\times2^9)+(0\times2^8)+(0\times2^7)+(1\times2^6)+(0\times2^5)$
$+(0\times2^4)+(1\times2^3)+(0\times2^2)+(0\times2^1)+(0\times2^0)$

$512+64+8$

$1001001000_2 = 584_{10}$

Decimal to Octal $\quad 584_{10} = 1110_8$

8	584	r. 0
8	73	r. 1
8	9	r. 1
8	1	r. 1
	0	

NO.:
DATE:

$5ECD25_{16} + EEDC_{16} = 5FBC01_{16}$

Hexadecimal to Decimal

$5ECD25_{16} = (5\times16^5)+(14\times16^4)+(12\times16^3)+(13\times16^2)+(2\times16^1)+(5\times16^0)$

$5{,}242{,}880 + 917{,}504 + 49{,}152 + 3{,}328 + 32 + 5$

$5ECD25_{16} = 6212901_{10}$

$EEDC_{16} = (14\times16^3)+(14\times16^2)+(13\times16^1)+(12\times16^0)$

$57344 + 3584 + 208 + 12$

$EEDC_{16} = 61148_{16}$

Decimal to Binary

$6212901_{16} = 10111101100110100100101_2$

2	6212901	r. 1
2	3106450	r. 0
2	1553225	r. 1
2	776612	r. 0
2	388306	r. 0
2	194153	r. 1
2	97076	r. 0
2	48538	r. 0
2	24269	r. 1
2	12134	r. 0
2	6067	r. 1
2	3033	r. 1
2	1516	r. 0
2	758	r. 0
2	379	r. 1
2	189	r. 1
2	94	r. 0
2	47	r. 1
2	23	r. 1
2	11	r. 1
2	5	r. 1
2	2	r. 0
2	1	r. 1
	0	

$61148_{10} = 1110111011011100_2$

2	61148	r. 0
2	30574	r. 0
2	15287	r. 1
2	7643	r. 1
2	3821	r. 1
2	1910	r. 0
2	955	r. 1
2	477	r. 1
2	238	r. 0
2	119	r. 1
2	59	r. 1
2	29	r. 1
2	14	r. 0
2	7	r. 1
2	3	r. 1
2	1	r. 1
	0	

```
  10111101100110100100101
+        1110111011011100
-------------------------
  10111111011110000000001
```

0101	1111	1011	1100	0000	0001
↓	↓	↓	↓	↓	↓
5	F	B	C	0	1

1. Subtract the following:

$11011_2 - 01100_2 = 01111_2$

$$
\begin{array}{r}
1\cancel{1}011 \\
-\ 01100 \\
\hline
01111
\end{array}
$$

$346_8 - 235_8 = 111_8$

Octal to Decimal

$346_8 = (3\times8^2)+(4\times8^1)+(6\times8^0)$

$192+32+6$

$346_8 = 230_{10}$

$235_8 = (2\times8^2)+(3\times8^1)+(5\times8^0)$

$128+24+5$

$235_8 = 157_{10}$

Decimal to Binary

$230_{10} = 11100110_2$

2	230	r. 0
2	115	r. 1
2	57	r. 1
2	28	r. 0
2	14	r. 0
2	7	r. 1
2	3	r. 1
2	1	r. 1
	0	

$157_{10} = 10011101_2$

2	157	r. 1
2	78	r. 0
2	39	r. 1
2	19	r. 1
2	9	r. 1
2	4	r. 0
2	2	r. 0
2	1	r. 1
	0	

$$
\begin{array}{r}
11\cancel{1}\cancel{0}\cancel{0}\,1\cancel{1}\cancel{0} \\
-\ 10011101 \\
\hline
01001001
\end{array}
$$

Binary to Decimal

$01001001_2 = (0\times2^7)+(1\times2^6)+(0\times2^5)+(0\times2^4)+(1\times2^3)+(0\times2^2)+(0\times2^1)+(1\times2^0)$

$64+8+1$

$01001001_2 = 73_{10}$

Decimal to Octal

$73_{10} = 111_8$

8	73	r. 1
8	9	r. 1
8	1	r. 1
	0	

DATE:

$5EC66_{16} - 5233A_{16} =$

Hexadecimal to Decimal

$5EC66_{16} = (5\times16^4)+(14\times16^3)+(12\times16^2)+(6\times16^1)+(6\times16^0)$

$327,680 + 57344 + 3072 + 96 + 6$

$5EC66_{16} = 388198_{10}$

$5233A_{16} = (5\times16^4)+(2\times16^3)+(3\times16^2)+(3\times16^1)+(10\times16^0)$

$327,680 + 8192 + 768 + 48 + 10$

$5233A_{16} = 336698_{10}$

Decimal to Binary

$388198_{10} = 1011110110001100110_2$

2	388,198	r. 0
2	194,099	r. 1
2	97,049	r. 1
2	48,524	r. 0
2	24,262	r. 0
2	12,131	r. 1
2	6,065	r. 1
2	3032	r. 0
2	1,516	r. 0
2	758	r. 0
2	379	r. 1
2	189	r. 1
2	94	r. 0
2	47	r. 1
2	23	r. 1
2	11	r. 1
2	5	r. 1
2	2	r. 0
2	1	r. 1
	0	

$336698_{10} = 1010010001100111010_2$

2	336,698	r. 0
2	168,349	r. 1
2	84,174	r. 0
2	42,087	r. 1
2	21,043	r. 1
2	10,521	r. 1
2	5,260	r. 0
2	2,630	r. 0
2	1,315	r. 1
2	657	r. 1
2	328	r. 0
2	164	r. 0
2	82	r. 0
2	41	r. 1
2	20	r. 0
2	10	r. 0
2	5	r. 1
2	2	r. 0
2	1	r. 1
	0	

```
  1011110110001100110
- 1010010001100111010
  -------------------
  0001100111101011100
```

0000	1100	1111	0101	1100
0	C	F	5	C

VICTORY

2. Multiply the following:

$1001_2 \times 110_2 = 110110_2$

```
   1001
X   110
   ----
   0000
+ 1001
 1001
 ------
 110110
```

$234_8 \times 227_8 = 56004_8$

Octal to Decimal

$234_8 = (2\times8^2)+(3\times8^1)+(4\times8^0)$

$128+24+4$

$234_8 = 156_{10}$

$227_8 = (2\times8^2)+(2\times8^1)+(7\times8^0)$

$128+16+7$

$227_8 = 151_{10}$

Decimal to Binary

$156_{10} = 10011100_2$

```
2|156 r.0
2|78  r.0
2|39  r.1
2|19  r.1
2|9   r.1
2|4   r.0
2|2   r.0
2|1   r.1
  0
```

$151_{10} = 10010111$

```
2|151 r.1
2|75  r.1
2|37  r.1
2|18  r.0
2|9   r.1
2|4   r.0
2|2   r.0
2|1   r.1
  0
```

```
          10011100
        X 10010111
        ----------
          10011100
         10011100
        10011100
       00000000
+     10011100
     00000000
    00000000
   10011100
   ---------------
   101110000000100
```

$\boxed{101}\ \boxed{110}\ \boxed{000}\ \boxed{000}\ \boxed{100}$

5 6 0 0 4

NO.:
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3. Divide the following:

$10 / 10011_2 =$

$$\begin{array}{r} 1001.1 \\ 10 \overline{)10011.1} \\ \underline{10} \\ 0 \\ \underline{-0} \\ 1 \\ \underline{-0} \\ 11 \\ \underline{-10} \\ 10 \\ \underline{-10} \\ 0 \end{array}$$

$5 / 756_8$

$\boxed{7}$ $\boxed{5}$ $\boxed{6}$

↓ ↓ ↓

111 101 110

$$\begin{array}{r} 16500164 \\ 5 \overline{)111101110} \\ \underline{-5} \\ 41 \\ \underline{-36} \\ 31 \\ \underline{-31} \\ 0011 \\ \underline{-5} \\ 41 \\ \underline{36} \\ 30 \\ \underline{-24} \\ 4 \end{array}$$

$A / FACE_{16}$

$$\begin{array}{r} 1914 \\ A \overline{)FACE} \\ \underline{-A} \\ 5A \\ \underline{-5A} \\ 0C \\ \underline{-A} \\ 2E \\ \underline{-28} \\ 6 \end{array}$$

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4. Convert to one's complement

1010_2 → 0101

1010 → 0101

11110000_2 → 00001111

11110000 → 00001111

10100001_2 → 01011110

10100001 → 01011110

5. Convert to two's complement

1010_2 → 0101 → 0101 + 1 = 0110

11110000_2 → 00001111 → 00001111 + 1 = 00010000

10000000_2 → 01111111 → 01111111 + 1 = 10000000

01111111_2 → 100000000 → 100000000 + 1 = 100000001

6. Convert these negative decimal values to negative binary using two's complement

$-192_{10} = 101000000_2$

2 | 192 = 0
2 | 96 = 0
2 | 48 = 0
2 | 24 = 0
2 | 12 = 0
2 | 6 = 0
2 | 3 = 1
2 | 1 = 1
0

$192_{10} = 11000000_2$

0 0 1 1 1 1 1 1
+ 1
1 0 1 0 0 0 0 0 0 //
8 7 6 5 4 3 2 1 0

$-2^8 + 2^6$

$-256 + 64 = -192$

$-16_{10} = 10000_2$

2 | 16 r. 0
2 | 8 r. 0
2 | 4 r. 0
2 | 2 r. 0
2 | 1 r. 1
0

10000

01111

01111
+ 1
10000 //
4 3 2 1 0

$-2^4 = -16$

$-1_{10} = 1_2$

$2 \underline{|1} \; r.1$
0

$1 \to 0$
$+1$
$\overline{\quad 1 \quad}$

$-1^{0} = -1$

7. Given 78.75_{10}, show its single precision floating point data representation

Step 1: 78_{10}

$2 \underline{|78} \; r\,0$
$2 \underline{|39} \; r.1$
$2 \underline{|19} \; r.1$
$2 \underline{|9} \; r.1$
$2 \underline{|4} \; r\,0$
$2 \underline{|2} \; r.0$
$2 \underline{|1} \; r.1$
0

0.75_{10}

$0.75 \times 2 = 1.50 \Rightarrow 1$
$0.50 \times 2 = 1.00 \Rightarrow 1$

(1001110.11_2)

Step 2 Single Precision $(1.N)_2{}^{E-127}$

1001110.11_2
1.001110×2^6

Step 3 $(1.N)_2{}^{E-127} = \underbrace{1.0011\,1011}_{N} \times 2^6$

$E - 127 = 6$
$E = 133 \longrightarrow 10000101_2$

0	10000101	001110....
1 bit	8 bits	23 bits