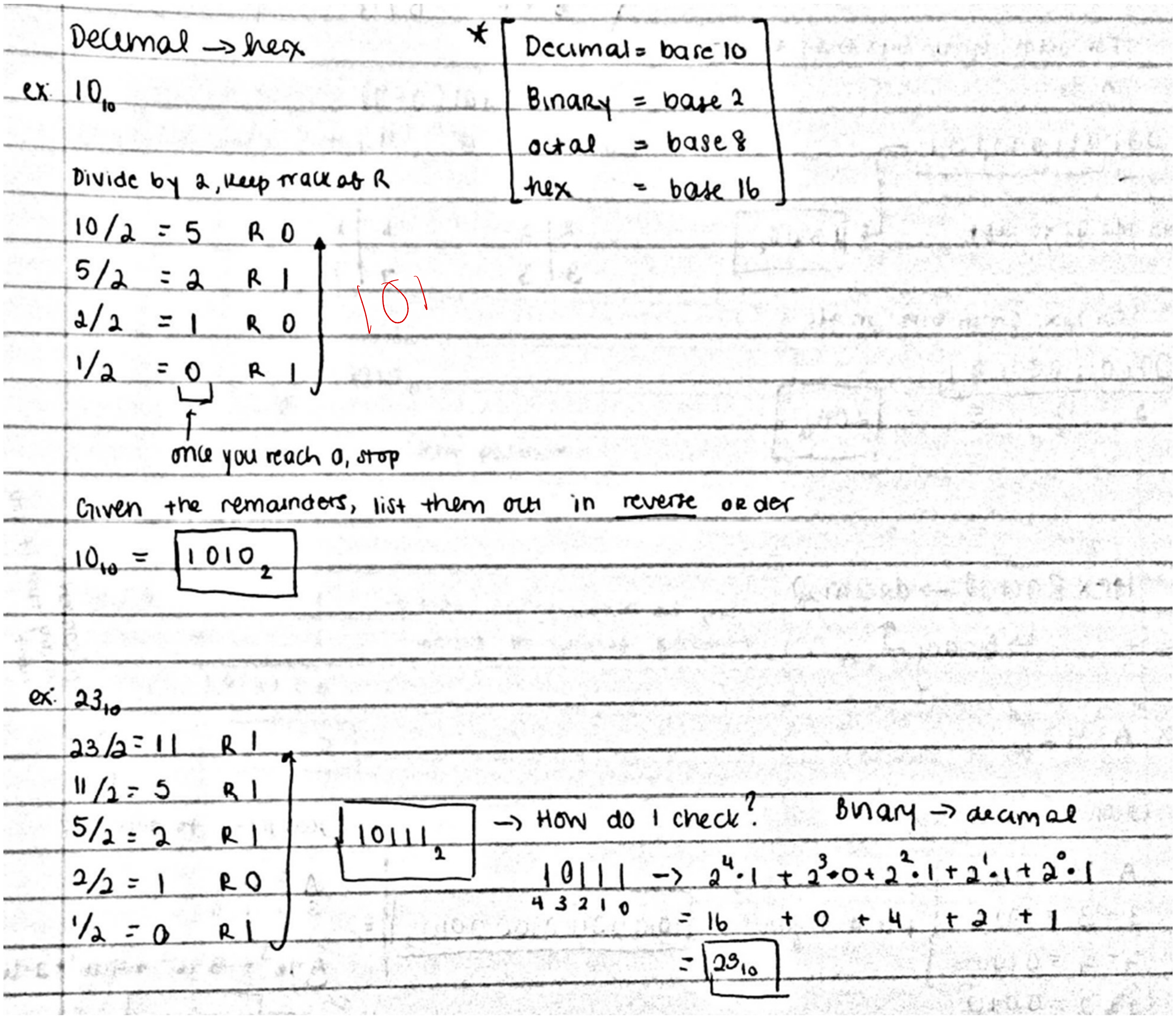

Decimal -> hex

* Decimal = base 10
Binary = base 2
octal = base 8
hex = base 16

ex: 10_{10}

Divide by 2, keep track of R

$10/2 = 5$ R 0
$5/2 = 2$ R 1
$2/2 = 1$ R 0
$1/2 = 0$ R 1

101

once you reach 0, stop

Given the remainders, list them out in <u>reverse</u> order

$10_{10} = \boxed{1010_2}$

ex: 23_{10}

$23/2 = 11$ R 1
$11/2 = 5$ R 1
$5/2 = 2$ R 1
$2/2 = 1$ R 0
$1/2 = 0$ R 1

$\boxed{10111_2}$ -> How do I check? Binary -> decimal

$\underset{4}{1}\underset{3}{0}\underset{2}{1}\underset{1}{1}\underset{0}{1} \rightarrow 2^4 \cdot 1 + 2^3 \cdot 0 + 2^2 \cdot 1 + 2^1 \cdot 1 + 2^0 \cdot 1$

$= 16 + 0 + 4 + 2 + 1$

$= \boxed{23_{10}}$

decimal to hex

decimal to binary to hex

*Get familiar w/ your powers of 2!

ex. 10110101_2 10101 ← everymis here is ngtive

100 01 to binar,

$\underset{7\,6\,5\,4\,3\,2\,1\,0}{10110101}$ ½ ½ code = $2^7 + 2^5 + 2^4 + 2^2 + 2^0 = 128 + 32 + 16 + 4 + 1 = \boxed{181_{10}}$

base 8

Binary → hex & octal

base 16 — base 8

# bits to represent	16 = 4 bits ($2^4 = 16$)	8 = 3 bits ($2^3 = 8$)

*convert groups to decimal, then look up corresponding digit →

ex. 1011000101

For octal, Group bits from RIGHT in 3s

$\underbrace{001}\,\underbrace{011}\,\underbrace{000}\,\underbrace{101} \rightarrow \boxed{1305_8}$

just add 0s to left

For hex, group bits in 4s

$\underbrace{0010}_{2}\,\underbrace{1100}_{12}\,\underbrace{0101}_{5} = \boxed{2C5_{16}}$

Digits

Hex (0-15)

0	0	7	7	E	14
1	1	8	8	F	15
2	2	9	9		
3	3	A	10		
4	4	B	11		
5	5	C	12		
6	6	D	13		

Octal (0-7)

0	0	4	4
1	1	5	5
2	2	6	6
3	3	7	7

Hex & octal → decimal

↳ Binary ⤴

ex. $A342_{16}$

you can convert to binary first if you want

① convert to binary

A = 10 = 1010

3 = 3 = 0011

4 = 4 = 0100

2 = 2 = 0010

put it together = $\boxed{1010\,0011\,0100\,0010_2}$ =

② convert to decimal

$\underset{3\,2\,1\,0}{A\,3\,4\,2}$

$A \cdot 16^3 + 3 \cdot 16^2 + 4 \cdot 16^1 + 2 \cdot 16^0$

10 = $\boxed{41794_{10}}$

if you know we are working with signs or not

We've been working with positive numbers... what about negative? Two's complement

Let MSB be the sign bit

↳ 0 = positive

1 = negative

One's complement - out dated since ... has two representations of zero

Decimal → signed binary

① determine the sign + 0 − 1

② convert to binary

③ flip the bits → one's complement 1→0 0→1

④ + 1 → two's complement

ex: $\boxed{1}0110_2$

negative number

2×2×2 append sign bit →

4×4

$\underset{4\,3\,2\,1\,0}{10110} = -(2^4)+2^2+2^1$ $-(2^4)+2^2+2$

negate first value

$-16+4+2$

$-12+2$

$= -16+4+2 = \boxed{-10}$

ex −34

deal with positive 34.

34 → binary = 0100010_2

6

add bit to represent positive

34/2=17 0

17/2=8 1

8/2=4 0

4/2=2 0

2/2=1 0

1/2=0 1

100010

0111 01

Flip bits: 1011101

6

(−)

add 1: 1011101

$+ \quad\quad 1$

1011110

→ treat carry values as you would in normal addition

consider all

10111 6

answer: $\boxed{1011110}$

How do we check?

Same as in previous example

$\underset{6\,5\,4\,3\,2\,1\,0}{1011110} = -(2^6)+2^4+2^3+2^2+2^1$ ✓

$= -64+16+8+4+2 = -34$ ✓

Notes

- one's complement not preferred because has 2 representations of 0 (+0 & −0)
- 2's complement: there are only a range of values you can represent given n bits $[-2^{n-1}, 2^{n-1}-1]$ $[-2^{n-1}, 2^{n-1}-1]$

this is very to important to keep in mind!

if you don't work with right bits you are in risk for overflow

- the 2's / 1's complement of a positive number is the binary representation itself.

ex: 12

$= \boxed{01100_2}$

need to show it is positive

Convert +12 to binary

12/2

5 bits

n=5

ONLY NEGATIVE

16/2=8 0

8/2=4 0

4/2=2 0

2/2=1 0

1/2=0 1

+16 can't fit in it

10000