Name:	Date:
Topic: 1.0 Computer Number Systems	**Period:**

2	Expanded	place
10	Exponential	position
base	Factor	subscript
Binary	Hexadecimal	symbols
Decimal	how many	

Main Ideas	Notes
Number System	A positional number system defines: • which _____ are use • _____ _____ symbols are used • what each _____ in the number means Common Number Systems • _____ Number System - Uses 10 symbols per digit • _____ Number System - Uses 2 symbols per digit • _____ Number System - Uses 16 symbols per digit The number of symbols allowed per digit is the _____ or radix of that number system. The base is written with a _____ such as 10011100_2. Decimal is a base _____ number system. Binary is a base ____ number system.

1.0.a

Place the following numbers in the number system that they could represent:

1. 01110010
2. FA084C
3. PQPQPP
4. 769213
5. YYNNYN

Binary	Decimal	Hexadecimal

What is a possible way to represent 16 symbols to make a base 16 number system?

How could you encode a base 36 number system?

Main Ideas	Notes
Expanded Form of Decimal Number	_____ Form means that each digit is written as a separate number according to its _____ value. The decimal number 683.57 In Expanded Form is: $600 + 80 + 3 + 0.5 + 0.07$ In Expanded _____ Form is: $6 \times 100 + 8 \times 10 + 3 \times 1 + 5 \times \frac{1}{10} + 7 \times \frac{1}{100}$ In Expanded _____ Form is: $6 \times 10^{2} + 8 \times 10^{1} + 3 \times 10^{0} + 5 \times 10^{-1} + 7 \times 10^{-2}$

Thousands	Hundreds	Tens	Ones		Tenths	Hundredths
	6	8	3	.	5	7

CFU 1.0.b

Identify the place value (hundreds, tens, ones, tenths, hundredths, etc.) of the digit in each of the following decimal numbers and write it in expanded form:

- 15.32, the 2 is in the _____ place, in Expanded Factor Form expands to _____
- 850.40, the 8 is in the _____ place, in Expanded Exponential Form expands to _____

Expanded Form in Binary	The expanded form of binary replaces the 10 in the exponent with a 2. The binary number 1100.11_2 In Expanded Form is: $1000_2 + 100_2 + 0.1_2 + 0.01_2$ In Expanded _____ Form is: $1 \times 8 + 1 \times 4 + 1 \times \frac{1}{2} + 1 \times \frac{1}{4} = 12\frac{3}{4}$ In Expanded _____ Form is: $1 \times 2^{3} + 1 \times 2^{2} + 1 \times 2^{-1} + 1 \times 2^{-2}$

Eights	Fours	Twos	Ones		Halves	Quarters
1	1	0	0	.	1	1

CFU 1.0.c

Determine the values of the following binary numbers:

1. 1100.01_2 = _____$_{10}$
2. 1001_2 = _____$_{10}$
3. 1010.1_2 = _____$_{10}$
4. 1111.11_2 = _____$_{10}$

Eights	Fours	Twos	Ones		Halves	Quarters
				.		

Name:	Date:
Topic: 1.1 Conversion From Decimal To Binary	**Period:**

Word Bank

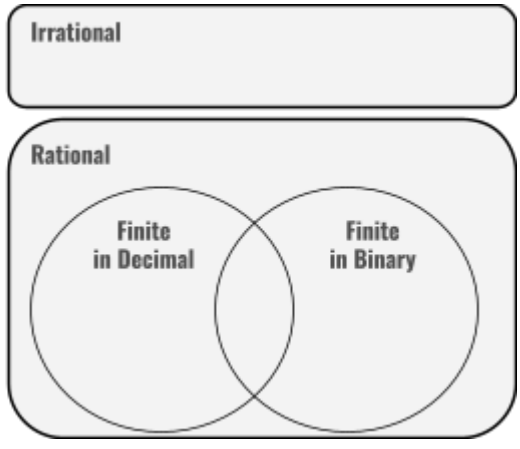
2	finite	rational
decomposing	fractions	zero
denominator	numerator	

Main Ideas	Notes
Mismatched number systems	A _____ number is any number that can be written as a simple fraction where both the top number (_____) and the bottom number (_____) are integers, and the bottom number is not _____. Not all rational numbers can be represented as a _____ number (a number that can be written without repeating decimals). In **decimal**, only _____ with a denominator divisible by 2 or 5 are finite. In **binary**, only numbers with a denominator divisible by a power of ____ are finite.

CFU
1.1.a

Place the following numbers in the best category describing that number.

1. Pi
2. $\sqrt{2}$
3. 1/2
4. 1/3
5. 1/5



What might be a problem with not being able to represent amounts like $0.10 finitely in binary?

Reflection

Main Ideas	Notes
Subtraction Method	Convert from decimal to binary by _____ (breaking up) a number into all the binary place values that add up to your number. _____ _____ _____ _____ _____ **16 8 4 2 1** 1. Create a placeholder for all the binary place values that are less than your number. 2. Find the largest number that is still less than your number. a. place a one in that place holder b. subtract that place value from your number 3. Repeat step 2 until your number is zero and all your place holder values add up to your original number. **Example: The number 22 can subtract 16, leaving 6, 6 can subtract 4 leaving 2. 22 = 16 + 4 + 2 = 10110_2**
CFU 1.1.b	*Convert the following decimal numbers to their binary equivalent using the subtraction method:* 1) 17 2) 23 3) 57 4) 105
Remainder Method	Convert from decimal to binary by repeatedly dividing by the base number and using the remainder as the next digit (right-to-left) of the new number. **Example: The number 13 ÷ 2 = 6 remainder 1, 6 ÷ 2 = 3 remainder 0, 3 ÷ 2 = 1 remainder 1. Rebuild as 1101_2 = 8 + 4 + 1 = 13**
CFU 1.1.c	*Convert the following decimal numbers to their binary equivalent using the remainder method:* 5) 61 6) 133 7) 253

Name:	Date:
Topic: 1.2 Adding in Binary	Period:

0	column
1	left
10	right
11	row

Main Ideas	Notes
Carrying (or Regrouping)	You can add directly in binary, if you follow the same procedure as in decimal. But it is helpful to note that: $0_2 + 0_2 =$ ___ $_2$ $0_2 + 1_2 =$ ___ $_2$ $1_2 + 1_2 =$ _____ $_2$ $1_2 + 1_2 + 1_2 =$ _____ $_2$ 1. Add one _____ at a time starting from the _____ column. 2. Carry any 2's digit. 3. Do this until you have reached the largest place value. Try it: $011010_2 + 011011_2$

1.2.a

Add the following number is binary (without converting to decimal for adding).

$011010_2 + 010011_2$ $\quad$ $111110_2 + 011011_2$ $\quad$ $111010_2 + 111001_2$

Name:	Date:
Topic: 1.3 Hexadecimal	Period:

16	C	F
A	D	nibble
B	digit	one
binary	divide	right
byte	E	zero

Main Ideas	Notes
Why hexadecimal?	All computer data is stored in groups of 8 bits called a _____. Every _____ (4 bits) of binary can directly translate to one _____ of hexadecimal. It is easier to write the _____ number 01101010_2 as $6A_{16}$ or 0x6A. The hexadecimal is a base-_____ number and is a short-hand for binary data.
Hexadecimal to Decimal	Each place value is 16 times the place value to the right: **B 3 F** **256 16 1** In Expanded Factor Form: $B_{16} \times 256 + 3_{16} \times 16 + F_{16} \times 1$ In Expanded Factor Form (in decimal values): $11 \times 256 + 3 \times 16 + 15 \times 1$ In Expanded Form: $2816 + 48 + 15 = 2879$ **Hexadecimal Symbols:** 10 = ___ 11 = ___ 12 = ___ 13 = ___ 14 = ___ 15 = ___

1.3.a

Convert the following hexadecimal numbers to decimal:

$9F_{16}$ ACE_{16} $F07_{16}$

Main Ideas	Notes
Decimal to Hexadecimal	Use the remainder method to convert decimal to hexadecimal by using the remainder to continuously _____ by 16. Example: 41,959 0 r 10 16 ⟌ 10 r 3 16 ⟌ 163 r 14 16 ⟌ 2622 r 7 16 ⟌ 41959 Translate the 4 values 10, 3, 14 and 7 to their hexadecimal symbols: **$A3E7_{16}$**

CFU 1.3.b

Convert the following decimal numbers to their hexadecimal equivalent using the remainder method:

9456 **80,933,479**

Binary-to-Hexadecimal Hexadecimal-to-Binary	Because a nibble can be 0000 - 1111 which is 0 through 15, a binary number can be grouped in 4's from the 1's place (_____-to-left) to translate to hexadecimal. **01 1010 1101 0011**

CFU 1.3.c

*Convert the following **binary** numbers to hexadecimal:*

0110101111000111 **1001011011000101**

*Convert the following **hexadecimal** numbers to binary:*

8FB3 **E28C**

Name:	Date:
Topic: 1.4 Encoding Information with Binary	Period:

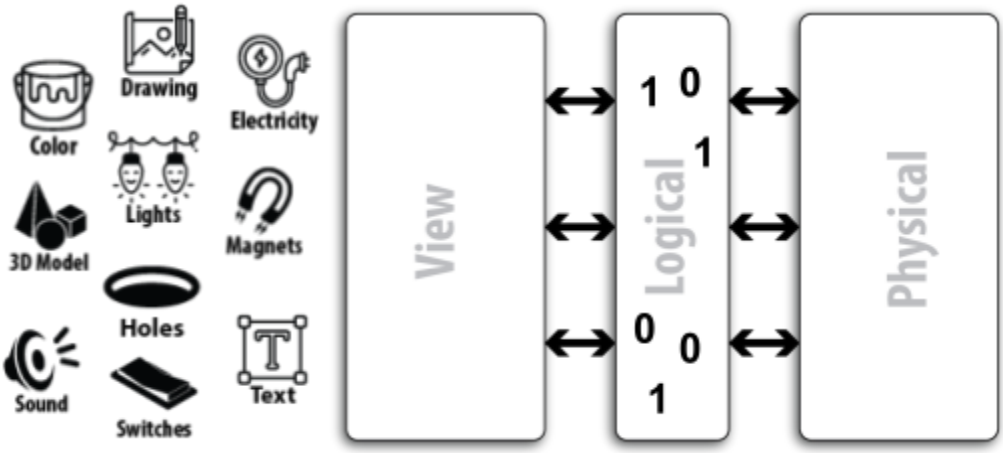
Word Bank

30	Characters	protocol
1024	Colors	Sounds
1,048,576	Drawings	View
binary	Logical	

Main Ideas	Notes
Logical Data Storage	**ALL** digital content is stored as a _____ number. Each of the following _____ Layer items can be translated to its _____ Layer mapping. • _____ are mapped to a number using a standard called ASCII. ASCII is a _____ for encoding text. For example 'A' is stored as the binary number 01000001_2 which is the decimal value 65. • _____ are mapped to a number by breaking up their composition into its red, green and blue components. • _____ are mapped to numbers by storing their volume at small intervals so the waves can be reproduced. • _____, 3D Models and illustrations are mapped to numbers by storing the geometry vectors as numbers that describe them.

CFU 1.4.a

*Place items in the **Physical Layer** that can represent zeros and ones physically. Place items in the **View Layer** that can be encoded to be stored on a computer and retrieved to be viewed again.*



Main Ideas	Notes

What benefit does having everything go through a logical layer of zeros and ones provide?

Storage Size

We typically think of a kilo representing 1,000 of something, but computer storage is measured in powers of 2.

Kilobyte = _____ (2^{10})

Megabyte = _____ (2^{20})

Gigabyte = 2 to the power of _____ (approx. 1.073 billion)

1.4.b

Determine the amount of storage you need for each of the following scenarios.

1) I have to submit an essay for an application and they told me that it should be less than 2000 words. (Assume a word is an average of 6 characters and one character for the space.)

2) I want a high-fidelity recording of a performance that will last for 5 minutes. Each sound point requires 4 bytes of data and the points are at 10 millisecond intervals.

Numeric Range of a binary number

# of bits	values	total unique values 2^n
1	0, 1	2
2	00, 01, 10, 11	$2^2 = 4$
4	000, 0001, …, 1111	$2^4 = 2 \times 2 \times 2 \times 2 = 16$
8	00000000, … 11111111	$2^8 = 256$

1.4.c

How many bits would I need to be able to store each of the following distinct values:

65,536

16,777,216

4,294,976,296

Main Ideas	Notes

Name:	Date:
Topic: 5.6 Digital Color Theory	Period:

1	bit	ones
2	byte	symbols
9	digits	tens
10	nibble	
binary	numbers	

Main Ideas	Notes
Topic A	
CFU	
Topic B	