Question 10

Convert the following numbers from binary (base-two) to decimal (base-ten):

- $10_2 =$
- $1010_2 =$
- $10011_2 =$
- $11100_2 =$
- $10111_2 =$
- $101011_2 =$
- $11100110_2 =$
- $10001101011_2 =$

Describe a general, step-by-step procedure for converting binary numbers into decimal numbers.
file 01202

Question 11

Convert the following numbers from decimal (base-ten) to binary (base-two):

- $7_{10} =$
- $10_{10} =$
- $19_{10} =$
- $250_{10} =$
- $511_{10} =$
- $824_{10} =$
- $1044_{10} =$
- $9241_{10} =$

Describe a general, step-by-step procedure for converting decimal numbers into binary numbers.
file 01204

Question 12

A numeration system often used as a "shorthand" way of writing large binary numbers is the *octal*, or base-eight, system.

Based on what you know of place-weighted numeration systems, describe how many valid ciphers exist in the octal system, and the respective "weights" of each place in an octal number.

Also, perform the following conversions:

- 35_8 into decimal:
- 16_{10} into octal:
- 110010_2 into octal:
- 51_8 into binary:

file 01286

Question 13

A numeration system often used as a "shorthand" way of writing large binary numbers is the *hexadecimal*, or base-sixteen, system.

Based on what you know of place-weighted numeration systems, describe how many valid ciphers exist in the hexadecimal system, and the respective "weights" of each place in a hexadecimal number.

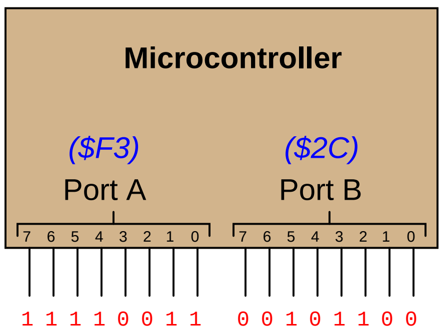
Also, perform the following conversions:

- 35_{16} into decimal:
- 34_{10} into hexadecimal:
- 11100010_2 into hexadecimal:
- 93_{16} into binary:

file 01206

Question 14

Digital computers communicate with external devices through *ports*: sets of terminals usually arranged in groups of 4, 8, 16, or more (4 bits = 1 *nybble*, 8 bits = 1 *byte*, 16 bits = 2 bytes). These terminals may be set to high or low logic states by writing a program for the computer that sends a numerical value to the port. For example, here is an illustration of a microcontroller being instructed to send the hexadecimal number `F3` to port A and `2C` to port B:



Suppose we wished to use the upper four bits of port A (pins 7, 6, 5, and 4) to drive the coils of a stepper motor in this eight-step sequence:

Step 1: `0001`
Step 2: `0011`
Step 3: `0010`
Step 4: `0110`
Step 5: `0100`
Step 6: `1100`
Step 7: `1000`
Step 8: `1001`

As each pin goes high, it drives a power MOSFET on, which sends current through that respective coil of the stepper motor. By following a "shift" sequence as shown, the motor will rotate a small amount for each cycle.

Write the necessary sequence of numbers to be sent to port A to generate this specific order of bit shifts, in hexadecimal. Leave the lower four bit of port A all in the low logic state.

file 02895

Question 15

Complete this table, performing all necessary conversions between numeration systems:

Binary	Octal	Decimal	Hexadecimal
10010			
		92	
			1A
	67		
1100101			
			122
		1000	
	336		
1011010110			

file 01207

Question 16

When representing non-whole numbers, we extend the "places" of our decimal numeration system past the right of the decimal point, like this:

Decimal place-weights

2	5	9	6	.	3	8	0	4
10^3	10^2	10^1	10^0		10^{-1}	10^{-2}	10^{-3}	10^{-4}

$2 \times 10^3 = 2000$	$3 \times 10^{-1} = {}^{3}/_{10}$
$5 \times 10^2 = 500$	$8 \times 10^{-2} = {}^{8}/_{100}$
$9 \times 10^1 = 90$	$0 \times 10^{-3} = {}^{0}/_{1000}$
$6 \times 10^0 = 6$	$4 \times 10^{-4} = {}^{4}/_{10000}$

How do you suppose we represent non-whole numbers in a numeration system with a base (or "radix") other than ten? In the following examples, write the place-weight values underneath each place, and then determine the decimal equivalent of each example number:

Binary place-weights

1	0	0	1	.	1	0	1	1

Octal place-weights

4	0	2	7	.	3	6	1	2

Hexadecimal place-weights

C	1	A	6	.	3	2	B	9

file 01208

Question 17

Convert the following numbers (all between the values of 0 and 1) into decimal form:

- $0.001_2 =$
- $0.101_2 =$
- $0.10111_2 =$
- $0.005_8 =$
- $0.347_8 =$
- $0.34071_8 =$
- $0.00C_{16} =$
- $0.A2F_{16} =$
- $0.A2F09_{16} =$

file 01209

Question 18

Complete this table, performing all necessary conversions between numeration systems. Truncate all answers to three characters past the point:

Binary	Octal	Decimal	Hexadecimal
101.011			
		25.2	
			4.B
	72.52		
1011.101			
			AC.11
		934.79	
	641.7		
101100.1			

file 01210

Question 19

In digital computer systems, binary numbers are often represented by a fixed number of bits, such as 8, or 16, or 32. Such bit groupings are often given special names, because they are so common in digital systems:

- byte
- nybble
- word

How many binary bits is represented by each of the above terms?

And, for those looking for more challenge, try defining these terms:

- nickle
- deckle
- chawmp
- playte
- dynner

file 01223