

Number Systems - Tutorial Sheet

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November 13, 2015

Question 1 : Binary numbers

(a) Express the following binary numbers as decimal numbers

(i) 101

(iii) 11011

(ii) 1101

(iv) 100101

(b) Express the following decimal numbers as binary numbers

(i) 6

(iii) 37

(ii) 15

(iv) 77

Question 2

A number is expressed in base 5 as $(234)_5$. What is it as decimal number? Suppose you multiply $(234)_5$ by 5. what would be the answer in base 5.

Question 3

Perform the following binary additions

(i) $1011 + 1111$

(iii) $1010 + 11010$

(ii) $10101 + 10011$

(iv) $101010 + 10101 + 101$

Question 4

Perform the binary additions

- $(10111)_2 + (111010)_2$
- $(1101)_2 + (1011)_2 + (1111)_2$

Question 5

Perform the binary subtractions using both the bit-borrowing method and the two's complement method.

- $(1001)_2 - (111)_2$
- $(110000)_2 - (10111)_2$

Question 6

Perform the binary multiplications

- $(1101)_2 \times (101)_2$
- $(1101)_2 \times (1101)_2$

Question 7

- (a) What is highest Hexadecimal number that can be written with two characters, and what is it's equivalent in decimal form? What is the next highest hexadecimal number?
- (b) Which of the following are not valid hexadecimal numbers?
- | | |
|---------|-----------|
| (i) A5G | (iii) EEF |
| (ii) 73 | (iv) 101 |

Question 8 : Binary Substraction

Exercises:

- | | |
|-------------------|------------------------|
| (i) $110 - 10$ | (iv) $10001 - 100$ |
| (ii) $101 - 11$ | (v) $101001 - 1101$ |
| (iii) $1001 - 11$ | (vi) $11010101 - 1101$ |

Question 9

- (a) Suppose 2341 is a base-5 number. Compute the equivalent in each of the following forms:
- (i) decimal number
 - (ii) hexadecimal number
 - (iii) binary number
- (b) Perform the following binary additions
- (i) $1011 + 1111$
 - (ii) $10101 + 10011$
 - (iii) $1010 + 11010$

Question 10

Calculate working in hexadecimal

- $(BBB)_{16} + (A56)_{16}$
- $(BBB)_{16} - (A56)_{16}$

Question 11

Write the hex number $(EC4)_{16}$ in binary. Write the binary number $(11110110101)_2$ in hex.

Question 12

Express the decimal number 753 in binary, base 5 and hexadecimal.

Question 13

Express 42900 as a product of its prime factors, using index notation for repeated factors.

Question 14

Express the recurring decimals

- (i) $0.727272\dots$
- (ii) $0.126126126\dots$
- (iii) $0.7545454545\dots$

as rational numbers in its simplest form.

Question 15

Given that π is an irrational number, can you say whether $\frac{\pi}{2}$ is rational or irrational. or is it impossible to tell?

Question 16

- (i) Given x is the irrational positive number $\sqrt{2}$, express x^8 in binary notation
- (ii) From part (i), is x^8 a rational number?

Question 17

- (i) $5/7$ lies between 0.714 and 0.715.
- (ii) $\sqrt{2}$ is at least 1.41.
- (iii) $\sqrt{3}$ is at least 1.732 and at most 1.7322.

Question 18

- (i) Write down the numbers 0.0000526 in floating point form.
- (ii) How is the number 1 expressed in floating point form.

Question 19

- Deduce that every composite integer n has a prime factor such that $p \leq \sqrt{n}$.
- Decide whether 899 is a prime.

Question 20

- What would be the maximum number of digits that a decimal fraction with denominator 13 could have in a recurring block in theory?
- Can you predict which other fractions with denominator 13 will have the same digits as $1/13$ in their recurring block?