Worksheet

Suppose that the IEEE 754 standard discussed in Chapter 5 of the textbook had a 12 bit version. It might look like this:

s	e_1	e_2	e_3	e_4	e_5	b_1	b_2	b_3	b_4	b_5	b_6

If 12 bits were organized this way they would represent the number

$$(*) \qquad x = (-1)^s \, (1.b_1b_2b_3b_4b_5b_6)_2 \times 2^{(e_1e_2e_3e_4e_5)_2 - 16}$$

Note that the case $e_1 = \dots = e_5 = 0$ is an exception in such a system: the string of 12 zero bits represents $x = 0$.

(a) What is the largest number that this system can represent?

(b) What is the smallest positive number that this system can represent? (*I.e. what is the representable number to the right of zero? Use* $(*)$ *above and do not worry about subnormal numbers.*)

(c) What is the value of "machine epsilon" in this system?

(d) With the rule that any bit string with $e_1 = \dots = e_5 = 0$ represents $x = 0$, how many distinct numbers can be represented in this system? (*Use* $(*)$ *above and do not worry about subnormal numbers.*) For comparison, how many integers could be represented with a 12 bit string, using the usual representation of integers?