Math 370 Fall 2004 **SHOW ALL YOUR WORK** Quiz One

1. In a vain attempt to prevent Microsoft© from taking over the world, Machines de Buckmire International (MBI) is coming out with the Elppa, which uses brand-new 8-bit technology to represent floating-point numbers. It uses a 1-bit sign indicator, a 2-bit characteristic and a 5-bit mantissa. Here is the definition:

$$fl(x) = (-1)^s \times 16^{c-2} \times q$$

where the normalization is the the mantissa must be **non-zero**.

a. What is the largest normalized positive number MBI's Elppa can hold in memory?

0	1	1	1	1	1	1	1

$s = 0$
$c = 11_2 = 3$
$q = .11111_2 = 0.96875$

$Z = 16^{3-2} \cdot 0.96875 = \boxed{15.5}$

b. What is the smallest normalized positive number MBI's Elppa can hold in memory?

0	0	0	0	0	0	0	1

$s = 0$
$c = 0$
$q = 2^{-5} = \frac{1}{32}$

This is smallest normalized number

$A = 16^{-2} \cdot \frac{1}{32} = (2^4)^{-2} \cdot 2^{-5}$
$= 2^{-13} = \boxed{1.22 \times 10^{-4}}$

c. The following bit of memory in the Elppa represents the number -12.5.

1	11	11001

Find the **next largest** and **next smallest** numbers that the Elppa can represent in memory. (Show the memory representation and then compute the values.)

Next largest

1	1	1	1	1	0	0	0

$s = -1$
$c = 3$
$q = .11_2 = .75$

$-1 \cdot 16 \cdot .75 = \boxed{-12}$ or $\boxed{-8}$

Next smallest

1	1	1	1	1	0	1	0

$s = -1$
$c = 3$
$q = .1101_2 = 2^{-1} + 2^{-2} + 2^{-4} = 0.8125$

$-1 \cdot 16^{3-2} \cdot 0.8125$
$= \boxed{-13}$

d. What would the output be if you tried to multiply -2 by 8 on a MBI Elppa computer?

1	11	0	0	1	0	0

$= -2$

$-2 \times 8 = -16$ would cause

0	11	1	0	0	0	0

$= 8$

OVERFLOW