NAME KEY

SCORE 50 (50)

This is a closed book test. Reference materials allowed are both sides of an 8.5"x11" sheet and your calculator. Unless otherwise noted, all questions relate to the MIPS processor and its instruction set. Please turn in all your work done on this exam except for your cheat sheet.

4 pts For the binary numbers represented in two's complement form:

- 1) Do the operation as an ALU math unit would do it and indicate the binary result.
- 2) Was the Carry Flag set during the operation?
- 3) Does this condition of the Carry Flag indicate a correct or incorrect result?

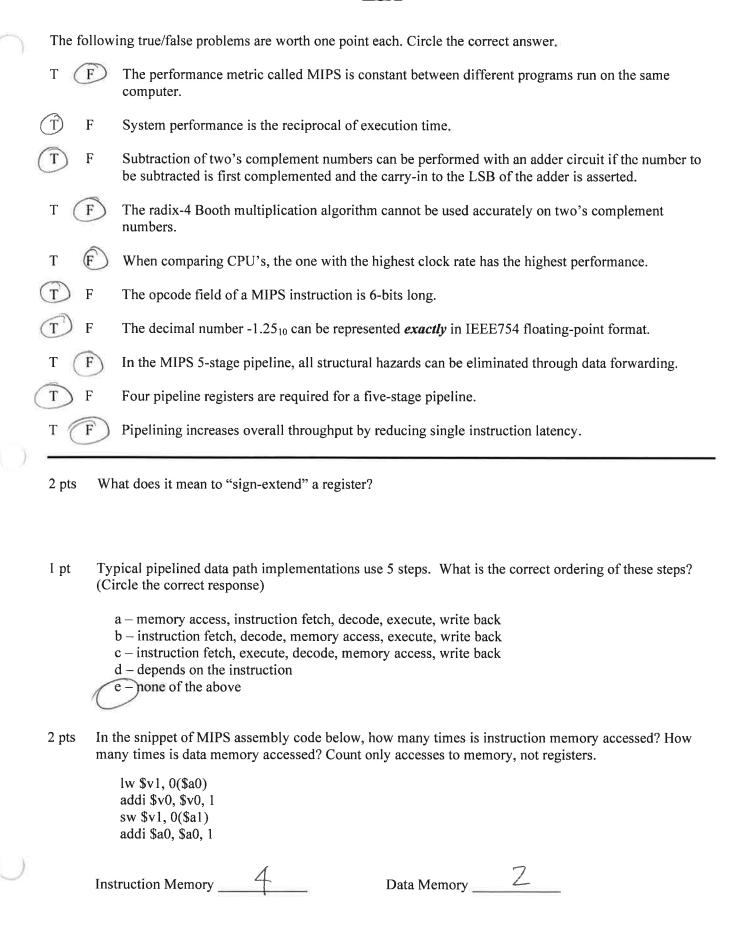
1000 0001 1110 0000 0000 0000 0000 0000

4 pts The 32-bit binary pattern shown above is in *floating-point number* format. What is the equivalent decimal number that it represents?

Sign Bit = 1 = Negative
Biaseo exp = 0000 0011
Real exp =
$$3-127=-124_2$$

mantiss A = $1.1100...$
Num Ber = $-(1.11e^{-124})_2 = -8.2285 \times 10^{-38}$

5 pts Show the IEEE754 32-bit floating point representation of the decimal number 60.625



You are part of a computer design team that has recently completed the architectural design and compiler for a new computer. The plan is to use a 1GHz clock. The following have been determined from simulation:

Instruction Class	CPI	Frequency
Α	2	30%
В	3	30%
C	3	25%
D	5	15%

Show all work for the problems below.

3 pts Find the CPI for the machine.

3 pts What is the MIPS rating for this computer?

3 pts What change in performance would result if the CPI for instruction class D decreased from 5 to 4 but a 5% slower clock would also be required?

New CPI:
$$(2)(.3) + 3(.3) + 3(.25) + 4(.15) = 2.25$$

New MIPS: $.95 \times 10^9 = 333 \text{ MIPS}$
 2.25

3 pts Suppose that a clever member of your design team discovers how to reduce the CPI of any one instruction class by one cycle without affecting the CPU clock rate (i.e. you can pick one of the four classes to be reduced by one clock period). Which instruction class would you choose? Why?

A:
$$1(.3) + 3(.3) + 3(.25) + 5(.15) = 2.7$$
 either one - Results in B: $2(.3) + 2(.3) + 3(.25) + 5(.16) = 2.7$ Bost performance

C: $2(.5) + 3(.3) + 2(.25) + 5(.15) = 2.75$

D: $2(.5) + 3(.3) + 3(.3) + 4(.15) = 2.85$

Using the Booth radix-4 multiplication algorithm show in longhand the multiplication of the two 4-bit decimal numbers: -2_{10} (1110₂) and $+3_{10}$ (0011₂). You may use the radix-2 method for 80% credit.

$$b = -2 = 1110$$
 $a = 0011$
 $2b = -4 = 1100$ $Result = -6 = 1010$
 $-b = 2 = 0010$ $Result = -6 = 1010$
 $-2b = 4 = 0100$

000	Do nothing
001	+b
010	+b
011	+2b
100	-2b
101	-b
110	-b
111	Do nothing

$$b=3=0011$$
 $2b=6=0110$
 $-b=-3=1101$
 $-2b=-6=1010$