1 Binary Problems

1.1 **Choose the best answer.** Given the following 8-bit integer binary variables:

`X1` = 01010001

`X2` = 00111110

What is the value in X3 after the following command:

```
ADD X3, X2, X1
```

A. 10001111

B. 00011110

C. Overflow or carry flag

D. 01000111

1.2 **Choose the best answer.** Given the following 8-bit integer binary variables:

`X1` = 10100100

`X2` = 11001011

What is the value in X3 after the following command:

```
ADD X3, X2, X1
```

A. 101101111

B. 01000011

C. 00100111

D. 01101111 and overflow or carry flag set.

1.3 **Choose the best answer.** How is the integer 256_{10} represented in memory?

A. 0000001000000000

B. 0000000011111111

C. 0000000100000001

D. 0000000010000000

E. 0000000100000000

1.4 **Choose the best answer.** How is the integer 2047_{10} represented in memory?

A. 0000011111111110

B. 0000011111111111

C. 0000111111111110

D. 0000001111111111

E. 0000100000000000

1.5 **Choose the best answer.** How is the integer 24_{10} represented in memory?

A. 00010111
B. 00011001
C. 00110000
D. 00011000
E. 00001100

1.6 **Choose the best answer.** How is the integer -25_{10} represented in memory?

A. 11101000
B. 11110100
C. 11001110
D. 11100110
E. 11100111

1.7 **Choose the best answer.** What does extending to 16 bits yield given -72_{10} in 8-bit 2's complement 10111000? (Sorry about the poor wording, but this is how it appears on the assessments!)

A. 1111111110110111
B. 1111111111011100
C. 1111111110111001
D. 1111111110111000
E. 1111111101110000

1.8 **Choose the best answer.**What does extending to 16 bits yield given 27_{10} in 8-bit 2's complement 00011011? (Sorry about the poor wording, but this is how it appears on the assessments!)

A. 0000000000110110
B. 0000000000011100
C. 0000000000011010
D. 0000000000011011
E. 0000000000001101

1.9 **Choose the best answer.** What is the decimal value of this 64-bit two's complement number? $1111111111111111111111111111111111111111111111111111111111111010_2$

A. -5
B. 5
C. 6
D. -6

E. 12

F. -12

1.10 **Choose the best answer.** What is the approximate range of a 64-bit signed integer?

A. 0 to 4,294,967,295

B. 0 to 18,446,744,073,709,551,615

C. -18,446,744,073,709,551,616 to 18,446,744,073,709,551,615

D. -9,223,372,036,854,775,808 to 9,223,372,036,854,775,807

1.11 **Choose the best answer.** What is the approximate range of a 64-bit unsigned integer?

A. 0 to 18,446,744,073,709,551,615

B. -18,446,744,073,709,551,616 to 18,446,744,073,709,551,615

C. 0 to 4,294,967,295

D. -9,223,372,036,854,775,808 to 9,223,372,036,854,775,807

2 Pipelining Problems

2.12 **Choose the best answer.** An instruction set has 12 steps and each step takes one clock cycle. What is the number of cycles needed to complete the instruction sets using a pipelined process to complete 140 instruction sets?

A. 11.993

B. 151

C. 1.079

D. 1.086

E. 12.0

F. 1680

2.13 **Choose the best answer.** An instruction set has 8 steps and each step takes one clock cycle. What is the average number of cycles needed to complete each instruction set using a pipelined process to complete 50 instruction sets?

A. 400

B. 57

C. 1.16

D. 1.14

E. 7.98

F. 8.0

2.14 **Choose the best answer.** An instruction set has 12 steps each taking 4 clock cycles to complete. What is the number of cycles needed to complete 90 instruction sets using a pipelined process?

A. 404

B. 48.0

C. 408

D. 4.533

E. 4.489

F. 4320

2.15 **Choose the best answer.** An instruction set has 5 steps each taking 4 clock cycles to complete. What is the average number of cycles needed to complete each instruction set using a pipelined process to complete 50 instruction sets?

A. 20.0

B. 4.4

C. 216

D. 1000

E. 4.32

F. 19.98

2.16 **Choose the best answer.** An instruction set has 10 steps each taking 2 clock cycles to complete. Approximately what is the average number of cycles needed to complete each instruction set using a pipelined process to complete 9.45×10^{36} instruction sets?

A. 20

B. 5.0

C. 0

D. 2×10^{36}

E. 2

2.17 **Choose the best answer.** An instruction set has 6 steps each taking 5 clock cycles to complete. If 120 sets of instructions are processed, what is the improvement (speedup) using a pipelined instead of a non-pipelined process?

A. 625

B. 20.833

C. 30

D. 0.826

E. 0.174

F. 5.76

2.18 **Choose the best answer.** An instruction set has 7 steps each taking 5 clock cycles to complete. If n sets of instructions are processed, what is the theoretical performance improvement (speedup) using a pipelined instead of a non-pipelined process as $n \to \infty$ (or for n is very large)?

A. 1.4

B. ∞

C. 7

D. 5

E. 35

2.19 **Choose the best answer.** How many minutes does it take to wash, dry, and fold four loads of laundry using a pipelining approach, given the following information?

One washer takes 10 minutes.

One dryer takes 30 minutes.

One folder takes 60 minutes.

A. 280

B. 340

C. 400

D. 220

E. 160

2.20 **Choose the best answer.** How many minutes does it take to wash, dry, and fold four loads of laundry using a pipelining approach, given the following information?

One washer takes 30 minutes.

One dryer takes 15 minutes.

One folder takes 45 minutes.

A. 225

B. 360

C. 270

D. 180

E. 135

2.21 **Choose the best answer.** How many minutes does it take to wash, dry, and fold seven loads of laundry using a pipelining approach, given the following information?

One washer takes 45 minutes.

One dryer takes 50 minutes.

One folder takes 40 minutes.

A. 435

B. 945

C. 385

D. 335

E. 485

2.22 **Choose the best answer.** A processor will execute an instruction set, S1, S2, and S3, four times using a pipeline approach.

S1 takes 3 clock cycles to complete.

S2 takes 4 clock cycles to complete.

S3 takes 2 clock cycles to complete.

How many clock cycles will this take the processor to complete?

A. 25

B. 21

C. 36

D. 33

E. 29

3 CPU Time Problems

3.23 **Choose ALL that apply.** How can the CPU performance of a program be improved?

A. Decreasing the clock cycles per instruction.

B. Decreasing the number of clock cycles.

C. Increasing the instruction count.

D. Decreasing the clock cycle length.

E. Increasing the response time for disk access.

F. Decreasing the clock rate.

G. Increasing the throughput of the processor.

3.24 **Choose the best answer.** A program with 1000e9 instructions runs alone on a CPU. The CPU clock rate is 7e9 cycles per second, i.e., 7 GHz. The average cycles per instruction is 6. How many seconds is the CPU performance for the task?

A. 0.042

B. 85.714

C. 857.143

D. 42000

E. 0.001

3.25 **Choose the best answer.** A program with 2000e14 instructions runs alone on a CPU. The CPU clock rate is 7e9 cycles per second, i.e., 7 GHz. The average cycles per instruction is 3. How many seconds is the CPU performance for the task?

A. 8571428.571

B. 42000

C. 0.0

D. 85714285.714

E. 0.011

3.26 **Choose the best answer.** A program with 1000e12 instructions runs alone on a CPU. The CPU clock rate is 3e9 cycles per second, i.e., 3 GHz. The average cycles per instruction is 4. Suppose that the clock rate is increased to 7 GHz. Approximately, what is the overall performance improvement?

A. 133333.33

B. 133.33%

C. 13.33%

D. 5.714%

E. 1333333.33

F. 57.14%

3.27 **Choose the best answer.** A program with 3000e13 instructions runs alone on a CPU. The CPU clock rate is 3e9 cycles per second, i.e., 3 GHz. The average cycles per instruction is 7. Suppose that the clock rate is increased to 4 GHz and the cycles per instruction is reduced to 5. Approximately, what is the overall performance improvement?

A. 866.67%

B. 25.0%

C. 86.67%

D. 250.0%

E. 70000000.0

F. 700000000.0

3.28 **Choose the best answer.** A program with 6000e9 instructions runs alone on a CPU. The CPU clock cycle time is 400e−12. The average cycles per instruction is 7. How many seconds is the CPU performance for the task?

A. 105.0

B. 16800.0

C. 0.0

D. 168000.0

E. 16800000

F. 0.001

3.29 **Choose the best answer.** A program with 5000e4 instructions runs alone on a CPU. The CPU clock cycle time is 800e−12 second. The average cycles per instruction is 3. How many seconds is the CPU performance for the task?

A. 1333333.333

B. 8.333

C. 0.12

D. 0.833

E. 0.48

F. 0.012

3.30 **Choose the best answer.** A program with 3000e3 instructions runs alone on a CPU. The CPU clock cycle time is 500e−12 second. The average cycles per instruction is 5. How many seconds is the CPU performance for the task?

A. 0.001

B. 0.833

C. 133.333

D. 13.333

E. 300000.0

F. 0.008

3.31 **Choose the best answer.** A program runs alone on a CPU. The CPU clock rate is 3e9 cycles per second, i.e., 3 GHz. It takes 12e11 clock cycles to complete the program. How many seconds is the CPU performance for the task?

A. 400.0

B. 36

C. 4000.0

D. 3.6

E. 40.0

F. 360

3.32 **Choose the best answer.** A program requires 7000e14 instructions to execute on a processor running at 5e9 cycles per second, i.e., 5 GHz. Suppose that 30% of the instructions execute in 3 cycles, 25% in one cycle, and 45% in 4 cycles. How many seconds is the CPU performance for the task?

A. 41300000000.0

B. 413000000.0

C. 41300000.0

D. 560000000.0

E. 4130000000.0

3.33 **Choose the best answer.** A program requires 7e9 instructions to execute on a processor running at 4 GHz with an average cycles per instruction of 4, resulting in an execution time of 7.0 seconds. Which adjustment improves overall performance approximately by 50%?

A. A rate of 5 GHz and 3 cycles per instruction.

B. A rate of 2 GHz and 5 cycles per instruction.

C. A rate of 6 GHz and 6 cycles per instruction.

D. A rate of 3 GHz and 2 cycles per instruction.

3.34 **Choose the best answer.** A program with 1000e14 instructions runs alone on a CPU. The CPU clock rate is 3e9 cycles per second, i.e., 3 GHz. The average cycles per instruction is 4. Suppose that the clock rate is increased to 5 GHz and the cycles per instruction is reduced to 2. Approximately, what is the overall performance improvement?

A. 2333.33%

B. 233.33%

C. 40.0%

D. 400.0%

E. 1333333333.33

F. 133333333.33

3.35 **Choose the best answer.** A program requires 3e9 instructions to execute on a processor running at 6 GHz. Suppose that 30% of the instructions execute in 2 cycles, 30% in 3 cycles, and 40% in 4 cycles resulting in an execution time of 1.55 seconds.
Which adjustment improves overall performance approximately by 19%?

A. 60% executes at 2 cycles and 40% at 3 cycles

B. 40% executes at 2 cycles and 60% at 3 cycles

C. 100% executes at 3 cycles

D. 100% executes at 2 cycles

3.36 **Choose the best answer.** A program with 3e9 instructions runs in 8 seconds on computer with a 4 GHz clock. A designer will build a new computer which can run the same program in 4 seconds by increasing the clock rate. What clock clock rate should the designer target?

A. 7.5

B. 8.0

C. 0.75

D. 0.8

E. 0.075

F. 80.0

3.37 **Choose the best answer.** Four processors (A, B, C, and D) have clock frequencies of 1 Mhz, 2 Mhz, 3 Mhz, and 4 Mhz respectively.

Suppose:

Processor A can execute an instruction with an average of 1

Processor B can execute an instruction with an average of 1

Processor C can execute an instruction with an average of 6

Processor D can execute an instruction with an average of 6

Which processor should be selected to improve performance using the same instruction set?

A. Processor A

B. Processor B

C. Processor C

D. Processor D

3.38 **Choose the best answer.** Four processors (A, B, C, and D) have clock frequencies of 2 Mhz, 3 Mhz, 5 Mhz, and 6 Mhz respectively.

Suppose:

Processor A can execute an instruction with an average of 3

Processor B can execute an instruction with an average of 3

Processor C can execute an instruction with an average of 4

Processor D can execute an instruction with an average of 4

Which processor should be selected to improve performance using the same instruction set?

A. Processor A

B. Processor B

C. Processor C

D. Processor D