

## 1 Binary Problems

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

X1 = 0001 0010

X2 = 0010 1010

What is the value in X3 after the following command:

ADD X3, X2, X1

- A. Overflow error or carry flag
- B. 0001 1110
- C. 0011 1100
- D. 0000 1111

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

X1 = 0101 0100

X2 = 1110 1100

What is the value in X3 after the following command:

ADD X3, X2, X1

- A. 0001 0100
- B. 1001 1000
- C. 0100 0000
- D. Overflow error or carry flag

**1.3 Choose the best answer.** How is the integer  $64_{10}$  represented in memory?

- A. 01000000
- B. 10000000
- C. 00111111
- D. 00100000

**1.4 Choose the best answer.** How is the integer  $69_{10}$  represented in memory?

- A. 01011100
- B. 10000000
- C. 01000101
- D. 01001001

**1.5 Choose the best answer.** How is the integer  $63_{10}$  represented in memory?

- A. 00111110
- B. 01111110
- C. 00111111
- D. 00011111

**1.6 Choose the best answer.** How is the integer  $-5_{10}$  represented in memory?

- A. 11110110
- B. 11111101
- C. 11111110
- D. 11111011

**1.7 Choose the best answer.** What does extending to 16 bits yield given  $-11_{10}$  in 8-bit 2's complement 11110101? (Sorry about the poor wording, but this is how it appears on the assessments!)

- A. 1111 1111 1111 0110
- B. 1111 1111 1111 1011
- C. 1111 1111 1110 1010
- D. 1111 1111 1111 0101

**1.8 Choose the best answer.** What does extending to 16 bits yield given  $98_{10}$  in 8-bit 2's complement 01100010? (Sorry about the poor wording, but this is how it appears on the assessments!)

- A. 0000 0000 0011 0001
- B. 0000 0000 1100 0100
- C. 0000 0000 0110 0010
- D. 0000 0000 0110 0011

## 2 Pipelining Problems

- 2.9 Choose the best answer.** An instruction set has 8 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 100 instruction sets?
- A. 800
  - B. 8.0
  - C. 1.08
  - D. 1.07
  - E. 107
  - F. 7.99
- 2.10 Choose the best answer.** An instruction set has 9 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 30 instruction sets?
- A. 8.967
  - B. 270
  - C. 1.267
  - D. 1.3
  - E. 38
  - F. 9.0
- 2.11 Choose the best answer.** An instruction set has 14 steps each taking 5 clock cycles to complete. What is the number of cycles needed to complete 30 instruction sets using a pipelined process?
- A. 2100
  - B. 7.333
  - C. 70.0
  - D. 220
  - E. 7.167
  - F. 215
- 2.12 Choose the best answer.** An instruction set has 5 steps each taking 4 clock cycles to complete. Approximately what is the average number of cycles needed to complete each instruction set using a pipelined process to complete  $2.15 \times 10^{50}$  instruction sets?
- A. 20
  - B. 0
  - C. 1.25
  - D. 4
  - E.  $4 \times 10^{50}$

- 2.13 Choose the best answer.** An instruction set has 5 steps each taking 4 clock cycles to complete. If 150 sets of instructions are processed, what is the performance improvement using a pipelined instead of a non-pipelined process?
- A. 20
  - B. 4.87
  - C. 0.205
  - D. 0.795
  - E. 30.8
  - F. 616
- 2.14 Choose the best answer.** An instruction set has 8 steps each taking 2 clock cycles to complete. If  $n$  sets of instructions are processed, what is the theoretical performance improvement using a pipelined instead of a non-pipelined process as  $n \rightarrow \infty$  (or for  $n$  is very large)?
- A. 8
  - B.  $\infty$
  - C. 4.0
  - D. 16
  - E. 2
- 2.15 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. 160
  - C. 400
  - D. 340
  - E. 220
- 2.16 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 40 minutes.
  - One dryer takes 25 minutes.
  - One folder takes 50 minutes.
- A. 215
  - B. 460
  - C. 165
  - D. 265

E. 315

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

S1 takes 3 clock cycles to complete.

S2 takes 8 clock cycles to complete.

S3 takes 8 clock cycles to complete.

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

A. 35

B. 51

C. 43

D. 95

E. 59

### 3 CPU Time Problems

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

- A. Increasing the length of the clock cycle
- B. Increasing the clock rate.
- C. Decreasing the response time for disk access.
- D. Decreasing the number of clock cycles
- E. Increasing the clock cycles per instruction.
- F. Increasing the instruction count.
- G. Increasing the throughput of the processor.

**3.19 Choose the best answer.** A program with  $5000 \times 10^9$  instructions runs alone on a CPU. The CPU clock rate is  $3 \times 10^9$  cycles per second, i.e., 3 GHz. The average cycles per instruction is 3. How many seconds is the CPU performance for the task?

- A. 0.002
- B. 0.0
- C. 5000.0
- D. 50000.0
- E. 0.0002
- F. 45000

**3.20 Choose the best answer.** A program with  $4000 \times 10^9$  instructions runs alone on a CPU. The CPU clock cycle time is  $700 \times 10^{-12}$ . The average cycles per instruction is 4. How many seconds is the CPU performance for the task?

- A. 0.0
- B. 11200.0
- C. 1120.0
- D. 22.857
- E. 11200000
- F. 0.0

**3.21 Choose the best answer.** A program runs alone on a CPU. The CPU clock rate is  $4 \times 10^9$  cycles per second, i.e., 4 GHz. It takes  $12 \times 10^{11}$  clock cycles to complete the program. How many seconds is the CPU performance for the task?

- A. 4.8
- B. 48
- C. 300.0
- D. 480
- E. 30.0
- F. 3000.0

- 3.22 Choose the best answer.** A program requires  $3000 \times 10^{11}$  instructions to execute on a processor running at  $10 \times 10^9$  cycles per second, i.e., 10 GHz. Suppose that 45% of the instructions execute in one cycle, 40% in 2 cycles, and 15% in 4 cycles. How many seconds is the CPU performance for the task?
- A. 5550.0
  - B. 55500.0
  - C. 5550000.0
  - D. 555000.0
  - E. 120000.0
- 3.23 Choose the best answer.** A program requires  $7 \times 10^9$  instructions to execute on a processor running at 4 GHz with an average cycles per instruction of 5, resulting in an execution time of 8.75 seconds. Which adjustment improves overall performance approximately by 25%?
- A. A rate of 3 GHz and 7 cycles per instruction.
  - B. A rate of 6 GHz and 6 cycles per instruction.
  - C. A rate of 5 GHz and 2 cycles per instruction.
  - D. A rate of 2 GHz and one cycle per instruction.
- 3.24 Choose the best answer.** A program with  $4000 \times 10^{11}$  instructions runs alone on a CPU. The CPU clock rate is  $4 \times 10^9$  cycles per second, i.e., 4 GHz. The average cycles per instruction is 6. Suppose that the clock rate is increased to 8 GHz and the cycles per instruction is reduced to 4. Approximately, what is the overall performance improvement?
- A. 600000.0
  - B. 200.0%
  - C. 5.0%
  - D. 50.0%
  - E. 20.0%
  - F. 60000.0
- 3.25 Choose the best answer.** A program requires  $1 \times 10^9$  instructions to execute on a processor running at 3 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 1.03333 seconds. Which adjustment improves overall performance approximately by 41%?
- A. 100% executes at 2 cycles
  - B. 20% executes at 2 cycles and 80% at 3 cycles
  - C. 80% executes at 2 cycles and 20% at 3 cycles
  - D. 100% executes at 3 cycles

## Answer Key

- 1: C
- 2: D
- 3: A
- 4: C
- 5: C
- 6: D
- 7: D
- 8: C
- 9: E
- 10: C
- 11: F
- 12: D
- 13: B
- 14: A
- 15: A
- 16: D
- 17: B
- 18: B, C, D, G
- 19: C
- 20: B
- 21: C
- 22: B
- 23: B
- 24: B
- 25: C