CMSC 240 Principles of Computer Organization
Spring 2021
Exam 1

This exam contains 7 Questions on pages numbered 1-9.

Please fill in all answers in the space provided in the form. Be sure to save your filled out exam as **LastFirst.pdf (e.g. CassidyKim.pdf)**. The exam should be e-mailed before the time mentioned in the email you received with this exam. No credit will be given for exams submitted late. Your Professor will confirm the receipt of the exam by e-mail.

All resources (textbook, class notes, completed labs and assignments, etc.) are permitted, but no assistance from another person. Please, refrain from web searching for answers (Google, etc.), it will mostly lead to wasted time and possibly misleading answers. If you copy anything directly from anywhere, please provide an appropriate citation of the source.

Good Luck!

Declaration

Sign the following statement **after** you have completed the examination by typing your name in the box provided. Your exam will **not be graded** without your signature:

> I certify that my responses in this examination are solely the product of my own work and that I have fully abided by the Bryn Mawr College Academic Integrity policy and instructions stated above while taking this exam.

Name: Solutions

For administrative use only!

1	2	3	4	5	6	7	Total

Question 1 (10 points) For each of the following, answer **True** or **False** as appropriate:

1. The basic electronic device used to build logic gates is called a transistor. True
2. 8-bits have 255 unique binary patterns. False
3. Faster computers can compute more things than slower ones. False
4. A voltage of 0 volts represents a binary digit 1 in the CPU. False
5. A voltage of 1.2 volts represents a binary digit 0 in the CPU. False
6. The idea of a universal computing device was developed by John von Neumann False
7. The Difference Engine was developed at the University of Pennsylvania in the 1940s. False
8. The hexadecimal number system is a positional number system. True
9. The Roman number system is a positional number system. False
10. The XOR gate is logically complete. False

Question 2 (20 points) Convert the following numbers as specified.

1. $(77)_{10}$ to base-2 (8-bits) — 0100 1101
2. $(-77)_{10}$ to base-2 (8-bits 2's complement representation) — 1011 0010
3. $(77)_{10}$ to base-16 — 4D
4. $(77)_{8}$ to base-10 — 63
5. $(77)_{16}$ to base-10 — 119
6. $(-34)_{10}$ to base-2 (8-bits 2's complement representation) — 1101 1110
7. $(-34)_{10}$ to base-2 (16-bits 2's complement representation) — 1111 1111 1101 1110
8. $(01011111)_{2}$ to base-16 — 5F
9. $(01011111)_{2}$ to base-10 — 95
10. $(11011111)_{2}$ to base-10 — -33

Question 3 (25 points) Below, use the latest value in each variable from the previous question (Note: Java both **`int`** and **`float`** in Java use 32-bits to represent values):

(a) Consider the Java statement:

```
int x = 4230;
```

Show the precise representation (in bits) that will be used to store the value of **x**.

0000 0000 0000 0000 0001 0000 1000 0110

(b) Next, consider the statement:

```
int y = -x * 2;
```

Show the precise representation (in bits) that will be used to store the value of **y**.

1111 1111 1111 1101 1110 1111 0100 (-8460)

(c) Next, consider the statement:

```
int a = x + y;
```

Show the precise representation (in bits) that will be used to store the value of **a**.

1111 1111 1111 1111 1110 1111 0111 1010 (-4230)

(d) Next, consider the statement:

```
float w = x/2.0;
```

Show the precise representation (in bits) that will be used to store the value of **w**.

0 100 1010 000 0100 0011 0000 0000 0000

(e) Next, consider the statement:

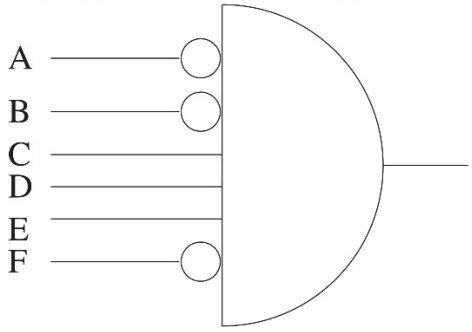
```
float z = -w * 3;
```

Show the precise representation (in bits) that will be used to store the value of **z**.

1 1000 1011 100 0110 0100 1000 0000 0000

Question 4 (10 points)

(a) For what values of ABCDEF will the output of the six-input AND gate be 1?
Also, what decimal value does that represent? Assume that A is the leftmost bit.



ABCDEF = 001110 = 14 (decimal)

(b) How many output lines will a five-input decoder have?

32 lines (2^5)

(c) How many output lines will a 16-input MUX have? How many Select lines will this MUX have?

1 output line
4 select lines since 2^4 = 16

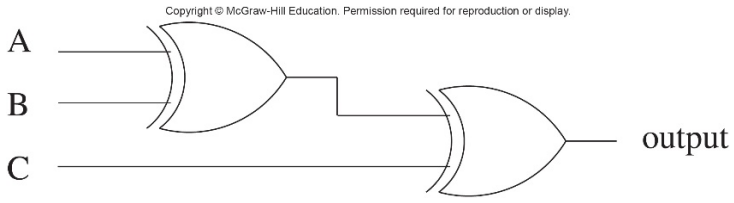
(d) A byte is 8-bits. A 4-bit quantity is called a nibble. If a byte-addressable memory has a 14-bit address. How many nibbles of storage are in this memory?

14 bit address = 2^14 = 16,384 addresses
Each address has 2 nubbles
Therefore, there will be 2*16,384 = 32768 (or 2^15) nibbles.

(e) If a computer has eight-byte addressability and needs three bits to access a location in memory, what is the total size of memory in bytes?

Each address has 8 bytes
There are 2^3 = 8 addresses
Therefore, 8*2^3 = 2^3 * 2^3 = 2^6 = 64 bytes.

Question 5 (10 points) The following logic circuit consists of two XOR gates. Fill in the Output truth table below.

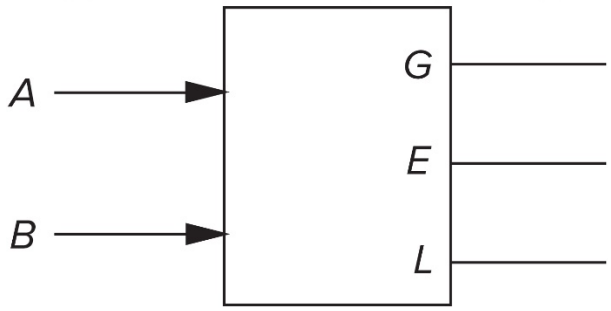


A	B	C	Output
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	1

Question 6 (10 points) A comparator circuit has two 1-bit inputs A and B and three 1-bit outputs G (greater), E (equal), and L (less than). Here is how the outputs are described:

G is 1 if A > B	E is 1 if A = B	L is 1 if A < B
0 otherwise	0 otherwise	0 otherwise

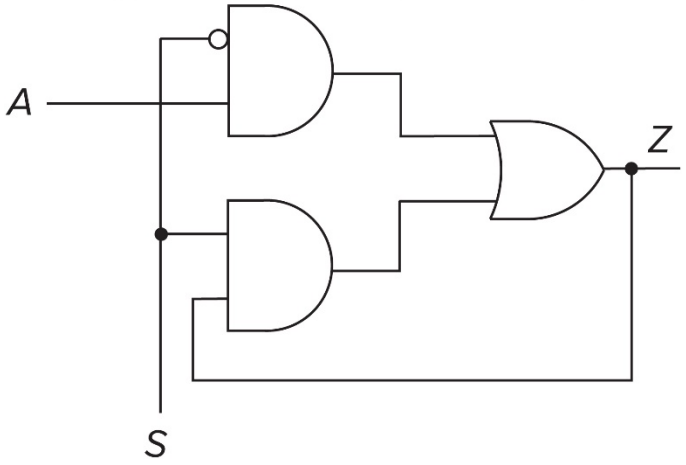
Here is a functional block diagram of a comparator:



Complete the truth table for the 1-bit comparator described above.

A	B	G	E	L
0	0	0	1	0
0	1	0	0	1
1	0	1	0	0
1	1	0	1	0

Question 7 (15 points) Study the circuit below and then answer the questions that follow.



(a) What is the output of this circuit at Z when the select line S is 0?

When S=0, Z = A

(b) What is the output of this circuit at Z when the select line S is 1?

When S=1, Z retains its previous value. i.e. it is unchanged.

(c) Is this logic circuit a storage element?

Yes.

Extra space just in case you need it...