This test is open book/notes. **Observe the Emory College Honor Code while taking this test.**

**NOTE:** show your work to get partial credit for incorrect answers — incorrect answers without any way to tell how the error occurred will not receive any credits.

**Question 1. (20 points)**

Give brief answers to the following questions (2 pts each)

1. What information is stored in the Instruction Register?

2. Give the 4 steps in the Instruction Execution Cycle.

3. Register \(d0\) contains the pattern

```
+-------------------+-------------------+-------------------+-------------------+
| 11111111 | 10101010 | 01010101 | 11110000 |
+-------------------+-------------------+-------------------+-------------------+
```

Show the content of register \(d0\) after executing the instruction \(\text{move.w } \#15,d0\)

```
+-------------------+-------------------+-------------------+-------------------+
|                    |                    |                    |                    |
+-------------------+-------------------+-------------------+-------------------+
```

4. Register \(d0\) contains the same pattern as the previous question. Show the content of register \(d0\) after executing the instruction \(\text{move.w } \#-15,d0\)

```
+-------------------+-------------------+-------------------+-------------------+
|                    |                    |                    |                    |
+-------------------+-------------------+-------------------+-------------------+
```
5. Show the 32 bit binary pattern in register D0 after executing the following assembler instructions:

\[
\text{move.l \#-1, d0} \\
\text{move.b \#1, d0}
\]

Answer:

+----------+----------+----------+----------+
| | | | |
+----------+----------+----------+----------+

6. What value is represented by the 8-bits 2’s complement code 11011101?

7. What is the 8-bits 2’s complement code for the value −19?

8. Show the 32 bit binary pattern in register D0 after executing the following assembler instructions:

\[
\text{move.l \#7, d0} \\
\text{divs \#3, d0}
\]

Answer:

+----------+----------+----------+----------+
| | | | |
+----------+----------+----------+----------+

9. Show the Octal (base-8) representation for the binary number 101011102:

Answer:

10. Show the Binary (base-2) representation for the Octal number 3648:

Answer:
Question 2. (20 pts)

All the number representation in this question are given in the base-3 representation!

Questions

- Given a number representation in the base-3 number system: $212_3$.
  What is the *value* represented by this representation? (5 pts)

- Compute the following addition in base-3 arithmetic. (5 pts)
  \[
  \begin{array}{cccccccccccc}
  1 & 1 & 1 & 2 & 2 & 1 & 1 & 1 & 2 & 1 & 1 & 1 \\
  + & 1 & 0 & 2 & 2 & 1 & 0 & 2 & 1 & 0 & 2 & 1 & 0 \\
  \hline
  \end{array}
  \]

- Compute the following subtraction in base-3 arithmetic. (5 pts)
  \[
  \begin{array}{cccccccccccc}
  2 & 0 & 1 & 2 & 2 & 0 & 1 & 2 & 1 & 1 & 2 & 1 & 2 & 1 & 2 & 1 \\
  - & 1 & 1 & 2 & 1 & 2 & 1 & 1 & 1 & 2 & 1 & 2 & 1 & 2 & 1 & 2 & 1 & 2 \\
  \hline
  \end{array}
  \]

- Compute $212_3 \times 212_3$ in base-3 arithmetic. Show the tail multiplication to get credits. (5 pts)
  \[
  \begin{array}{cccccccccccc}
  2 & 1 & 2 & 1 & 2 & 1 & 2 & 1 & 2 & 1 & 2 & 1 & 2 & 1 & 2 & 1 & 2 & 1 & 2 & 1 \\
  \hline
  \end{array}
  \]
Question 3. (10 pts)

- Given the following fixed point decimal number: 13.8125_{10}
  Give the fixed point binary (base-2) representation of this number. (5 pts)

- Give the IEEE float representation of the fixed point decimal number: \(-13.8125_{10}\) (5 pts)
  Note: use your answer on the previous question!
Question 4. (10 pts)

The variables \( x \), \( y \), \( z \) and \( \text{head} \) have been defined as follows:

- \( \text{short } x[] = \{2, 4, 5\}; \) // Initialized array with 3 values
- \( \text{int } y[10]; \) // Uninitialized array
- \( \text{final int } z = 10; \) // A symbolic constant value \( z \)
- \( \text{List head; } \) // A reference variable to a List object

Give the equivalent construct in M68000 assembler used to:

- Create the initialized array variable \( x \) (3 pts)
- Create the uninitialized array variable \( y \) (2 pts)
- Define the symbolic constant \( z \) (3 pts)
- Create the reference variable \( \text{head} \) (2 pts)
Question 5. (20 pts)

The variables $A$, $B$, $i$, $j$ and $head$ have been defined as follows: (you do not need to define them, just use them)

```c
byte i, A[10];
short j, B[10];
int k, C[10];

class List {
    byte value1;
    byte value2;
    int value3;
    List next;
}

List head;
```

The $head$ variable contains the address of the first element of a linked list whose elements have the structure given by the $List$ class.

Note: pay special attention to the operand size!

Translate the following assignment statements into M68000 instructions

1. $i = \text{byte} \ C[6]$; (5 pts)

2. $C[i+k] = j$; (5 pts)
3. head.next.next.value3 = i; (5 pts)

4. C[ A[i] ] = head.next.next.value2; (5 pts)
Question 6. (20 pts)

The variables x, y and z have been defined as follows: (you do not need to define them, just use them)

```c
byte x;
short y;
int z;
```

Translate the following assignment statements into M68000 instructions

1. \(z = -(y/x++)\); (10 pts)

2. \(z += y\%5 + ++x\); (10 pts)