Name:

Instructions

1. Write your name at the top of *this* page.
2. This is a closed-book exam. No form of communication is permitted (eg, talking, texting, etc.), except with the course staff.
3. No electronic devices are permitted.
4. There are 30 multiple-choice/short-answer questions in this exam, each worth 3 points. You have 75 minutes to answer the questions.
5. Each question must be answered *with a pencil* as shown below. It will be marked as incorrect otherwise.

   Multiple-choice question: (A) (B) (C) (D) (E)

   Short answer question: 42
6. You may use the blank spaces for any scratch work.
7. Discussing the exam contents with anyone who has not taken the exam is a violation of the academic honesty code.

Problem 1. Consider the decimal (base 10) number 189.

a. What is the 8-bit binary (base 2) representation of the number?

(A) 01000010
(B) 01001010
(C) 10111101
(D) 10110101
(E) 01000011

b. What is the 8-bit binary (base 2) representation of the negative of the number (ie, -189)?

(A) 01000010
(B) 10111101
(C) 01001010
(D) 10110101
(E) 01000011

c. What is the octal (base 8) representation of the number?

d. What is the hexadecimal (base 16) representation of the number?

Problem 2. Consider the following Marvin program `Mystery.marv`:

```
0    read     r0
1    read     r1
2    mod      r13 r0 r1
3    write    r13
4    halt
```

a. What does the program write when run with inputs `13` and `5`?

b. What does the program write when run with inputs `5` and `13`?

Problem 3. Consider running a program `mystery.py` as follows:

```
$ python3 mystery.py Fred Carol Bob Alice Dan Eve
```

a. How many values does `sys.argv` contain?

b. What is the value of the expression `sys.argv[4]`?

(A) `"Eve"`

(B) `"Bob"`

(C) `"mystery.py"`

(D) `"Dan"`

(E) `"Alice"`

Problem 4. Consider the following program `mystery.py`:

```
import stdio
import sys

x = int(sys.argv[1])
y = int(sys.argv[2])
a = x * x
b = 2 * x * y
c = y ** 2
stdio.writeln(a - b + c)
```

a. What does `mystery.py` write when run with inputs 9 and 4?

b. What does `mystery.py` write in general?

(A) $y^2 - x^2$

(B) $(x - y)^2$

(C) $(x + y)^2$

(D) $x^2 + y^2$

(E) $x^2 - y^2$

Problem 5. Consider the following program `mystery.py`:

```
import stdio
import sys

n = int(sys.argv[1])
x = 0
i = 1
while i <= n:
    if i % 2 != 0:
        y = i * i
        x += y
    i += 1
stdio.writeln(x)
```

a. What does the program write when run with input 10?

b. What does the program write in general?

(A) Sum of the squares of even integers less than or equal to n

(B) Sum of the squares of integers less than or equal to n

(C) Sum of the squares of odd integers less than or equal to n

(D) The value n^2

(E) Sum of the integers less than or equal to n

Problem 6. Consider the assignment `a = range(1, 16, 3)`.

a. What is the last value in `a`?

b. What is the value of the expression `len(a)`?

c. What is the value of the expression `sum(a)`?

Problem 7. Consider the following code fragment:

```
a = []
for x, y in zip([1, 2, 3], [4, 5, 6]):
    a += [x + y]
```

a. What is the value of the expression `len(a)`?

b. What is the value of the expression `max(a)`?

Problem 8. Consider the assignments `a = set("einstein")` and `b = set("turing")`.

a. What is the value of the expression `b - a`?

(A) `{"i", "r", "t", "n", "g", "e", "s", "u"}`

(B) `{"r", "u", "e", "g", "s"}`

(C) `{"n", "i", "t"}`

(D) `{"e", "s"}`

(E) `{"u", "g", "r"}`

b. What is the value of the expression `a & b`?

(A) `{"n", "i", "t"}`

(B) `{"i", "r", "t", "n", "g", "e", "s", "u"}`

(C) `{"u", "g", "r"}`

(D) `{"r", "u", "e", "g", "s"}`

(E) `{"e", "s"}`

Problem 9. Consider the following program `mystery.py`:

```
import stdio

x = stdio.readString()
y = stdio.readString()
stdio.write(x + "L" + y)
stdio.write(" ")
stdio.write(y + "R" + x)
stdio.writeln()
```

Next, suppose that the file `input.txt` contains the two strings `F` and `F` separated by a space.

a. What does the command `python3 mystery.py < input.txt` write?

(A) `FLFLFRFLFRFRFLFLFRFRFLFRFLFLFRF FRFRFLFRFLFLFRFRFLFLFRFLFRFRFLF`

(B) `FLF FRF`

(C) `F F`

(D) `FLFLFRF FRFRFLF`

(E) `FLFLFRFLFRFRFLF FRFRFLFRFLFLFRF`

b. What does the command `python3 mystery.py < input.txt | python3 mystery.py` write?

(A) `FLFLFRFLFRFRFLFLFRFRFLFRFLFLFRF FRFRFLFRFLFLFRFRFLFLFRFLFRFRFLF`

(B) `FLF FRF`

(C) `F F`

(D) `FLFLFRF FRFRFLF`

(E) `FLFLFRFLFRFRFLF FRFRFLFRFLFLFRF`

Problem 10. Consider the following functions:

```
def f(x, k = 3):
    return k * x + 1

def g(x, k):
    return x % k
```

a. What does `f(6, 5)` return?

b. What does `g(f(6), 5)` return?

c. What does `f(g(19, 7))` return?

Problem 11. Consider the assignment `a = range(0, 30, 6)`.

a. What does `sum(filter(lambda x: x % 4 != 0, a))` return?

b. What does `sum(map(lambda x: x // 4, a))` return?

Problem 12. Consider the following recursive function:

```
def mystery(a, b=0):
    if b == 0:
        return 1
    return a * mystery(a, b - 1)
```

a. What does `mystery(3)` return?

b. What does `mystery(3, 1)` return?

c. What does `mystery(3, 4)` return?

d. What does `mystery(a, b)` return in general about a and b?

(A) $a \bmod b$

(B) $|a - b|$

(C) $a + b$

(D) ab

(E) a^b

Solution 1.

a. `C`

b. `E`

c. `275`

d. `BD`

Solution 2.

a. `3`

b. `5`

Solution 3.

a. `7`

b. `E`

Solution 4.

a. `25`

b. `B`

Solution 5.

a. `165`

b. `C`

Solution 6.

a. `13`

b. `5`

c. `35`

Solution 7.

a. `3`

b. `9`

Solution 8.

a. `E`

b. `A`

Solution 9.

a. `B`

b. `D`

Solution 10.

a. `31`

b. `4`

c. `16`

Solution 11.

a. `24`

b. `14`

Solution 12.

a. `1`

b. `3`

c. `81`

d. `E`