There are 10 questions here, each worth 10 points. When you are done with the exam sign the Honor Pledge on the last page. If you are not taking the exam with the rest of the class please write your starting and stopping times on this page as well.

1. I am trying to write a program that will repeatedly ask for a name and then say hi to that person. The program should halt after it does this 100 times, or if it ever gets a blank name. Here is what I have:

```python
def main():
    done = False
    for x in range(0, 100):
        name = input( "Who? " )
        if name == "":
            done = True
        else:
            print ( "Howdy %s!" % name )
    main()
```

This program doesn’t halt when I give it a blank name. **Explain why.** You don’t need to fix the program; just say why it doesn’t stop when I give it a blank name.
2. What will the following program print?

```python
def G(n):
    while n > 0:
        print(n, end = " ")
        if n%2 == 0 and n%3 == 0:
            print()
            return
        n = n-1
    print()

def F(L):
    s = 0
    for x in L:
        s = s + x
    G(s)

def main():
    L = [3, 1, 5]
    for i in range(0, 3):
        F(L[i])

main()
```

```
3. What will the following program print?

```python
def main():
    string = ""
    s = "abcd"
    for letter in s:
        string = letter + string + letter
    print(string)

main()
```
4. Consider the following program. Function F returns a number that divides into x, main has a loop that prints values and the result of calling F on each value.

```python
def F(x):
    # This finds a number that divides into x
    for d in range(2, 20):
        if x%d == 0:
            return d

def main():
    x = 5
    while x >= 0:
        print( "%d is divisible by %d."%(x, F(x)))
        x = x-1
main()
```

When I run this it prints
5 is divisible by 5.
4 is divisible by 2.
3 is divisible by 3.
2 is divisible by 2.
and then it crashes. The error message refers to the print statement and says:
TypeError: %d format: a number is required, not NoneType

a) **Explain in one English sentence** what this error message means. What is “NoneType”?

b) **Explain what in the program causes this error**. You don’t need to fix the program, just say why it crashes.
5. Here is a program using classes and subclasses.

class Person:
    def __init__(self, name):
        self.name = name
        self.age = 0
    def __str__(self):
        return self.name

class Student(Person):
    def __init__(self):
        self.year = "Freshman"
    def changeYear(self, year):
        self.year = year
    def __str__(self):
        return "%s is a %s."%(self.name, self.year)

def main():
    p = Person( "Dumbledore" )
    print(p)
    h = Student( "Harry" )
    print(h)

main()

The first few lines of main() run correctly, but it crashes on the line
h = Student( "Harry" )
with the error message
TypeError: __init__() takes 1 positional argument but 2 were given

a) **Explain in one sentence why the program crashes.**

b) **Give a fix for the program** so that it runs correctly and prints “Harry is a Freshman.” You
don’t need to copy the program; just write onto the code above.
In the following program class Person has an instance variable self.friends that is a list of the Person objects who are friends with self.

```python
class Person:
    def __init__(self, name):
        self.name = name
        self.friends = []
    def __str__(self):
        return self.name
    def makeFriend(self, x):
        # x should be a Person
        self.friends.append(x)
        x.friends.append(self)
    def printFriends(self):
        print("Here are the friends of %s:",%(self.name))
        for x in self.friends:
            print("    ", x)

def main():
    f = Person("Fred Flinstone")
    f.makeFriend("Barney Rubble")
    f.makeFriend("Mr. Slate")
    f.printFriends()

main()
```

This program crashes on the line `x.friends.append(self)` called from the line `f.makeFriend("Barney Rubble")`.

The error message says

```
AttributeError: 'str' object has no attribute 'friends'
```

**a) Explain in one sentence what is wrong.**

**b) Fix the program.** You can write directly over my code.
You have probably used software systems that require you to create a password that includes certain kinds of characters. Let’s simplify this down to requiring passwords to include at least one digit. Write a program that repeatedly asks the user to enter a new password. If the string the user supplies contains a digit, your program should say “Your new password is “ and then print the string and exit the loop. If the string doesn’t contain a digit, your program should say “Bad password” and go around the loop again. If the user gives the empty string your program should say “You have no password.” and exit the loop. Here is a typical run of the program, with what the computer prints in bold:

```
Enter new password: bob
Bad password.
Enter new password: frodoLives
Bad password.
Enter new password: python3
Your new password is 'python3'.
```
8. File “F.txt” is a dictionary file consisting of lines of text with one word per line, such as:
   apple
   bob
   cat
d
   exams

Write a program that prints the words in this file, first printing all of the 1-letter words, then all of the 2-letter words, then the 3-letter words, and so forth. For the data above it would print:

1 letter words:
a
3 letter words:
   bob
   cat
5 letter words:
   apple
   exams
9. Write a **recursive** function HasDuplicates( L ) that takes a list L and returns True if at least one of the entries in L appears more than once, and False if the elements are all unique. For example, HasDuplicates( [1, 3, 2, 1, 4] ) returns True and HasDuplicates( [1, 3, 2, 7, 4] ) returns False. If you don’t see how to do this recursively you will get some credit for doing it iteratively (with a loop).
10. **Write a class Dice** that represents a pair of dice, each of which randomly chooses a value between 1 and 6. The constructor for Dice needs no arguments. Your class should have the following methods. These methods need no arguments (except self)

   - `roll()` gives random values between 1 and 6 to both dice
   - `values()` returns a tuple with the two dice values
   - `total()` returns the sum of the values of the two dice
   - `doubles()` returns True if both dice have the same value

For example, we might have an application program with the code

```python
    d = Dice()
    d.roll()
    if d.total() == 7:
        print( "Yippee, I rolled a 7!" )
```

You only need to write class Dice.
You can use this space for scratch work. If you want me to grade anything here, please indicate clearly which problem this applies to.
Please write and sign the Honor Pledge when you are finished with the exam.