Part I: Reading Python

1. What will this print?

```
total = 0
for i in range(4):
    for j in range(i,4):
        if (i+j)%3==0:
            total = total + 1

print total
```

2. What will this print?

```
a = [6,5,6,9,3,2,5,7,5,4,3,2,8,0,1]

idx = -1
while not a[idx]==5:
    idx = idx-1

print len(a)+idx
```

3. What will this print?

```
rabbit = 10
fox  = 3

i = 1

while i<3:

    rabbit = rabbit + rabbit/10 -
fox*rabbit/10
    fox    = fox + rabbit*fox/20

    i = i + 1

print rabbit,fox
```

4. What will this print?

```
def check(car,txt):

    cars = [["Renault","F"],["Peugeot","F"],
            ["Volkswagen","D"],["Audi","D"],
            ["Jaguar","E"],["Rover","E"],
            ["Toyota","J"],["Honda","J"]]

    sw = False
    for c in cars:

        if c[0].lower()==car.lower():

            if txt.upper().count(c[1])>0:
                sw = True
                break

    return sw

lst = ["Not ok.","Ok."]
print lst[int(check("renault","def"))]
```

5. What will this print?

```
from numpy import *

a = array([[2,7,1],
           [4,89,0],
           [2,3,5]])

print sum(a[:,2])
```

6. What will this print?

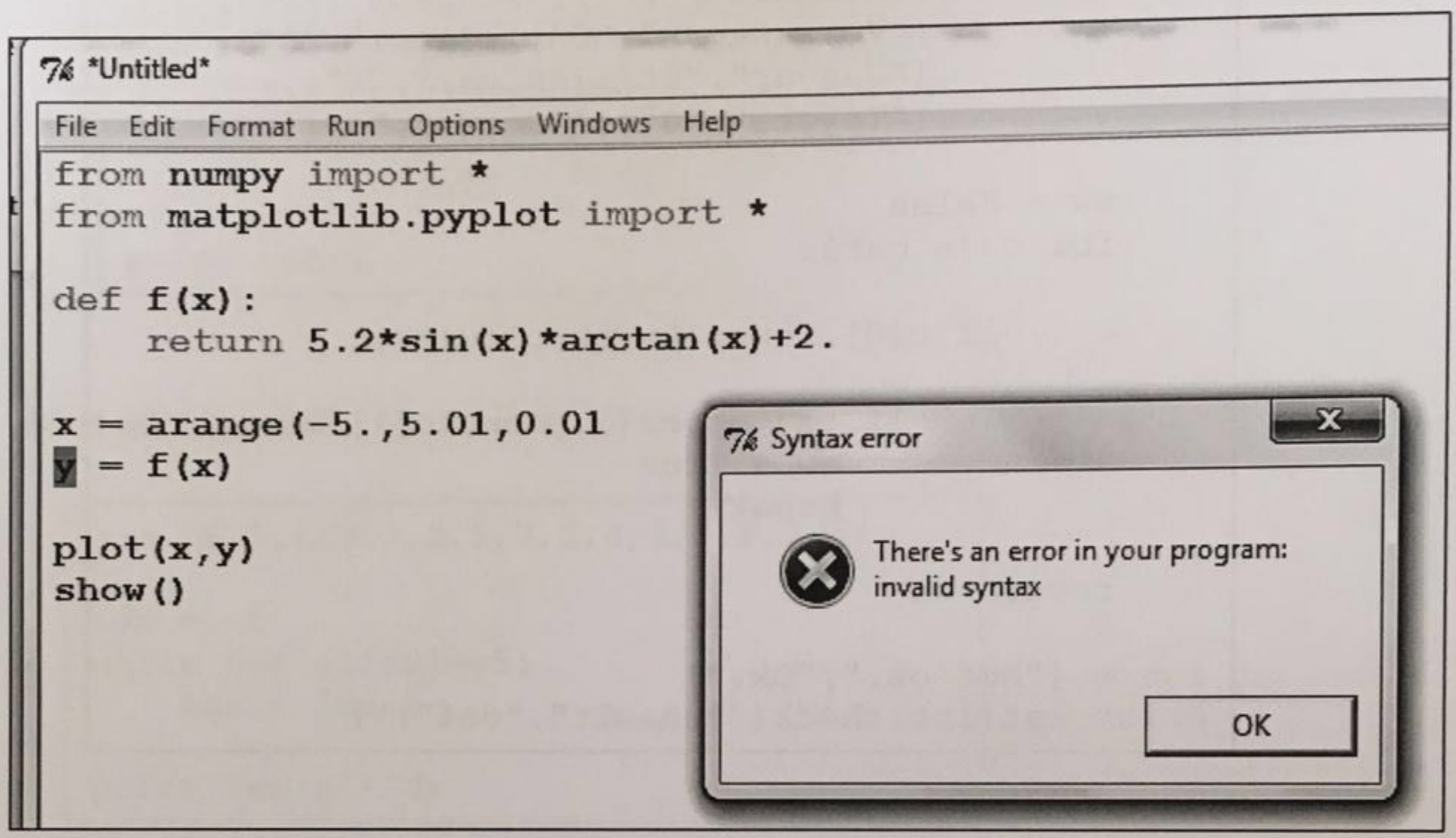
```
from numpy import *

a = array([2,7,1,4,89,0,2,3,5])

print sum(a[a%2==0])
```

Part II Debugging Python

7. What is the error in this code? (select the correct answer)



A. The variable y has not yet been defined as an array

B. The function call will not work as it contains arctan, this should be atan

C. The bracket is missing in the line before

D. All of the above answers are true.

E. The program contains no errors

8. What is the error in this code? (only one correct answer)

```
import pygame as pg
import random as rnd

pg.init()

reso = (800,600)
scr  = pg.display.set_mode(reso)

black = (0,0,0)
white = (255,255,255)
red   = (255,0,0)
green = (0,255,0)
blue  = (0,0,255)

color = (0,0,0)

for i in range(3):
    color[i] = 255

    x = int(rnd.random()*300 + 150)
    y = int(rnd.random()*400 + 200)
    pg.draw.circle(scr,color,(x,y),100)

    color[i] = 0
    pg.display.flip()

raw_input("Press Enter to quit")
pg.quit()
```

A. The program contains an indentation error
B. The program uses the wrong name for the random module
C. The program mixes floats and integers, causing a run-time error
D. The unused variables will generate a runtime error
E. The tuple does not allow item assignment as it is a constant
F. The raw_input is a function so should have an assignment statement
G. The variable i of the for-loop will cause an error when used as index in a list, array or tuple
H. The variable i of the for-loop will cause an 'index out of range' error
I. The display flip call should be outside the loop, not been indented
J. A bracket is missing in the line with the random function call
K. The random-function needs an argument
L. The program contains no errors

9. The program code below is part of the program which a lecturer wants to use to combine the scores of exam grades and bonus points (only one correct answer)

```
# Program to combine data from exam and bonus
# Read csv file into 2d list
def getdata(fname):
    f = open(fname,"r")
    lines = f.readlines()
    f.close()

    data = []
    for line in lines:
        data.append(line.split(";"))

    return data

# Make csv line of list
def csvline(lst):
    line = str(lst[0])
    for field in lst[1:]:
        line = line+";"+str(field)

    return line

# ------ Main

examdata  = getdata("examgrades.csv")[1:]

bonusdata = getdata("EN1Bonus.csv")[1:] + \
            getdata("EN2Bonus.csv")[1:] + \
            getdata("NL1Bonus.csv")[1:]

# Add to examdata

table = []

# For all students who did the exam:
for exam in examdata:

    # Did he/she do the exam?
    didexam = not (len(exam[3]) == 0)

    if didexam:
        # Exam data
        studnr = int(exam[0])
        studname = exam[2]
        exwhite = float(exam[3])
        exyellow = float(exam[4])
```

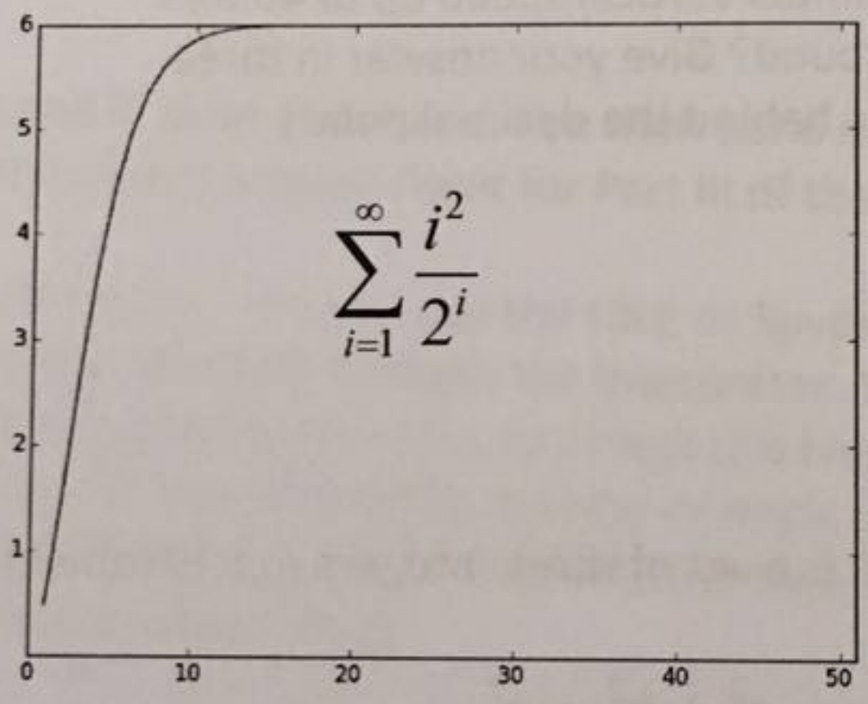
A. The getdata-function cannot be called with index-slicing as it is a function
B. The getdata-function cannot be added with the plus-sign as it is a function
C. The continuation character misses the extra backslash
D. The variable 'table' is wrong, should have been 'data' as this is the name used in the function getdata
E. The bonusdata overwrites the vairable examdata, which causes errors
F. The program contains a (double) indentation error
G. The program is unfinished but contains no errors

Part III Writing Python

10. Plot the following functions using Matplotlib and Numpy arrays. **How often** do the following functions f(x) and g(x) **intersect** at the interval $x \in [0,10]$?

$$f(x) = \sin x$$
$$g(x) = 0.7 + \cos 2x$$

11. Some series converge to a value, some do not. An example of a converging series is given next to the plot, which shows it's converging. When we look at the series, we find it converges to the value 6.000



To **which value** does the series $\sum_{i=1}^{\infty} \frac{1}{i^3}$ converge? Give the answer in five digits behind the decimal point.

12. The following equation has a number of integer solutions (x,y) :

$$x^2 - 2y^2 = 1$$

For positive integer values of x and y less than 100 there are three solutions:

(3,2)
(17,12)
(99,70)

The sum of the numbers of these pairs is 203.

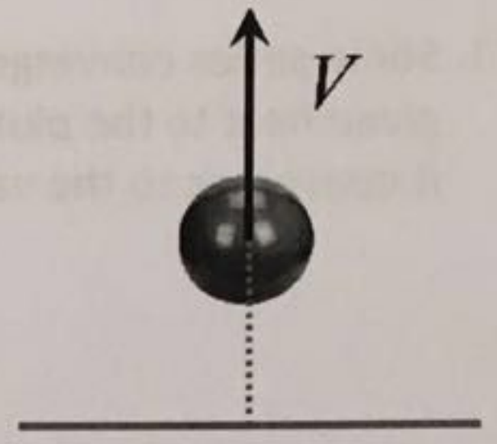
Now calculate the sum of all solution pairs x ,y for when **x and y** are positive integer numbers both **less than 1000.**

13. How long will it take for the ball to hit the ground? Give the time of flight in three digits behind the decimals. The following parameters are given:

Drag is given by: $D = 0.05\ V^2$, where V is the airspeed in m/s, drag force direction is opposite to the airspeed
The gravity force on the ball is a constant 10.0 Newton downwards.
The gravity constant g = 9.81 m/s^2

For the initial vertical velocity of 10. m/s upwards from the ground, the flight time is 1.8365 seconds.

What is **the time between the start** until the ball **hits the ground again** for an initial vertical speed up of 45 m/s upwards from the ground? Give your answer in three decimals (three digits behind the decimal point).



14. A Pythagorean triplet is a set of three integers (a,b,c) for which is true:

$$a^2 + b^2 = c^2$$

We can list the number of triplets $0 < a <= b <= N$

When $N=20$ we find the following 7 triplets:

(3, 4, 5)
(5, 12, 13)
(6, 8, 10)
(8, 15, 17)
(9, 12, 15)
(12, 16, 20)
(15, 20, 25)

Similarly for $N = 100$ we find 63 triplets. 63 is still less than 100, but the number of triplets gets closer to the value of N already.

What is the lowest N for which the number of triplets is greater than N itself?

Hint: *To find the range where to look for the lowest N for which the number of triplets is larger, try a few values for N first for the order of magnitude.*