1 Python language exercises

1. (5 points) Consider the following expression, intended to print the square root of 16:

\[ \text{pow}(16, (1/2)) \]

What is the result of this expression? How should it be changed, still using `pow`, to yield the correct answer?

2. (5 points) Define the variables \( x \) and \( y \) as lists of numbers, and \( z \) as a tuple.

\[ x = [1, 2, 3, 4, 5] \]
\[ y = [11, 12, 13, 14, 15] \]
\[ z = (21, 22, 23, 24, 25) \]

(a) What is the value of \( 3*x \)?
(b) What is the value of \( x+y \)?
(c) What is the value of \( x-y \)?
(d) What is the value of \( x[1] \)?
(e) What is the value of \( x[0] \)?
(f) What is the value of \( x[-1] \)?
(g) What is the value of \( x[:1] \)?
(h) What is the value of \( x[2:4] \)?
(i) What is the value of \( x[1:4:2] \)?
(j) What is the value of \( x[:2] \)?
(k) What is the value of \( x[:2] \)?
(l) What is the result of the following two expressions?

\[ x[3]=8 \]
\[ \text{print } x \]

(m) What is the result of the above pair of expressions if the list \( x \) were replaced with the tuple \( z \)?

3. (5 points) Define the variable \( s \) as the string \( s = "abcde" \).

(a) What is the value of \( 3*x \)?
(b) What is the value of \( x[1] \)?
(c) What is the value of \( x[-1] \)?
(d) What is the value of \( x[:2] \)?

4. (5 points) Write a program to find those numbers \( j = 100 \) that are equal to the sum of their factors.
5. (5 points) Define a “Big number” as a list of digits. Write a program whose first non-comment lines are two 20-digit numbers
\[
x = [3, 1, 4, 1, 5, 9, 2, 6, 5, 3, 5, 8, 9, 7, 9, 3, 2, 3, 8, 5]
\]
\[
y = [2, 7, 1, 8, 2, 8, 1, 8, 2, 8, 4, 5, 9, 0, 4, 5, 5, 3, 4, 9]
\]
Write a program that:

(a) Finds the sum (x+y) considered as 20-digit “big numbers” and prints it as a list of digits.

(b) Finds the product 15∗x considered as a product of “big numbers” and prints it as a list of digits.

Your program should be general enough that if x and y are changed to be 30-digit numbers, your program would still work correctly.

6. (8 points) Write a program to do the following tasks:

(a) Define a function named \texttt{dif2} that accepts an integer N as input parameter and constructs and returns an \(N \times N\) two-dimensional \texttt{numpy} array \(A\), with the value -2.0 on the main diagonal and the value +1.0 on the super-diagonal and the sub-diagonal.

(b) For N=10, construct a one-dimensional array \(b\) of length \(N\) filled with zeros except that the first element is 1.0 and the last element is -N. For N=10, solve the system \(Ax = b\) for \(x\).

(c) For N=20, construct a one-dimensional array \(c\) of length \(N\), filled with random numbers. For \(A\) from the \texttt{dif2} function, Solve the system \(Ay = c\) for \(y\) and then confirm that the solution you found is approximately correct by computing the relative norm of the residual error, \(\|Ay - c\|/\|c\|\). This value should be no larger than \(10^{-12}\).