1. The three main purposes of an operating system are:

- to execute user programs and make solving user problems easier

- to make the computer system convenient to use

- to use the computer hardware in an efficient manner

1. The purpose of system calls is to allow user programs to request services from the operating system.
2. Caching allows for frequently used data to be stored close to the CPU allowing for fast access and efficient data transfer. Caching solves the problem of efficiently providing data to the CPU as other forms of memory are much slower. It’s problems however are that it has limited storage and it is much more expensive than other types of memory.
3. Some services provided by an operating system are:  
   - User Interface  
   - Program Execution  
   - File system manipulation  
   - I/O Operations  
   - Resource Allocation

In the case of these 5 services, they are all able to be provided by user-level programs. Most programming languages are capable of creating user interfaces, executing programs, manipulating file systems(creation/deletion), handling I/O operations and managing resources.

1. a) 0  
    2  
    4  
    6  
    8

b) 100  
 93

86

79

72  
 65  
 58  
 51  
 44  
 37  
 30  
 23  
 16

9

2

c) 1  
 2  
 3  
 4  
 5  
 6  
 7  
 8

9

10

d) 2  
 4

8

16

32

64