Exercise Sheet 10

Exercise 1   (Virtualization and Emulation)

1. Explain the difference between emulation and virtualization.

2. Name a drawback of emulation against virtualization.

3. Explain how partitioning works.

4. Name the component of a computer that distributes the physical resources to the virtual machines in the partitioning virtualization concept.

5. Mark the sort of computer systems that usually implement the partitioning virtualization concept.

   ☐ Mobiltelefone   ☐ Desktop PCs   ☐ Mainframes   ☐ Workstations

6. Explain how application virtualization works.

7. Name an example for application virtualization.

8. Explain how full virtualization works.

9. Explain the function of the Virtual Machine Monitor (VMM).

10. Mark the correct answer that explains where the Virtual Machine Monitor (VMM) runs.

    ☐ The VMM runs *hosted* as an application in the host operating system.
    ☐ The VMM runs *bare metal* and replaces the host operating system.

11. Can all physical hardware resources be virtualized when full virtualization is used? If this is not possible, give an example where it does not work and explain your answer.

12. Give the number of privilege levels a x86-compatible CPU contains.

13. Give the privilege level number where the VMM runs.

14. Give the privilege level number where the VMs run.

15. Explain how VMs can access hardware resources when using full virtualization.

16. Name an example of a full virtualization implementation.

17. Explain how paravirtualization works.

18. Explain where the hypervisor runs when using paravirtualization.

☐ The hypervisor runs *hosted* as an application in the host operating system.
☐ The hypervisor runs *bare metal* and replaces the host operating system.

19. Give the privilege level number where the hypervisor runs when using para-virtualization.

20. Explain why a host operating system is required for using paravirtualization.

21. Explain what an unprivileged domain (Dom0) is when using Xen.

22. Explain what a Domain 0 (Dom0) is when using Xen.

23. Name a drawback of paravirtualization.

24. Explain how the privilege levels of x86-compatible CPUs have been modified for providing hardware virtualization.

25. Name an advantage of hardware virtualization.

26. Explain how operating system-level virtualization (containers/jails) works.

27. Name a drawback of operating system-level virtualization (containers/jails).

28. Name an example of an operating system-level virtualization (containers/jails) implementation.

29. Explain how storage virtualization works.

30. Explain how network virtualization via Virtual Local Area Networks (VLAN) works.

Exercise 2   (Shell Scripts, Loops)

1. Program a shell script, which generates with loops this output:

```
1
22
333
4444
55555
```

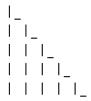2. Program a shell script, which generates with loops this output:

```
1
12
123
1234
12345
```

3. Program a shell script, which generates with loops this output:

```
|_
| |_
| | |_
| | | |_
| | | | |_
```

4. Program a shell script, which generates with loops this output:

```
*
**
***
****
*****
```

5. Program a shell script, which generates with loops this output:

```
*
**
***
****
*****
*****
****
***
**
*
```

6. Program a shell script, which generates with loops this output:

```
    *
   ***
  *****
 *******
*********
```