Question 1. [8 Points] Select ONLY ONE ANSWER (**the best answer**).

1.	2.	3.	4.	5.	6.	7.	8.
D	**C**	**C**	**B**	**D**	**D**	**A**	**B**
9.	**10.**	**11.**	**12.**	**13.**	**14.**	**15.**	**16.**
B	C	A	A	B	C	C	B

Question 2: [3Points]

2.1 Explain how interrupt are handled? [1 Points]

Interrupt transfers control to the interrupt service routine (0.5)
generally, through the interrupt vector, which contains the addresses of all the service routines (0.5)
Interrupt architecture must save the address of the interrupted instruction

2.2 What does the device status table contain? [1 Points]

contains entry for each I/O device (0.5) indicating its type, address, and state (0.5)

2.3 What is the purpose of device driver? [1 Points]

for each device controller to manage I/O
Provides uniform interface between controller and kernel (1 point)

Question 3: [3 Points]

3.1 Explain how mobile devices environment differs from a desktop computer from an OS designer perspective? [1.5 Points]

Mobile devices has unique environment in comparison to a desktop computer (0.5 marks for each, any three would be enough)

Extra features – more OS features (GPS, gyroscope)
Allows new types of apps like *augmented reality*
Handheld computers are resource poor,
optimized for usability and battery life
Limitation in space

3.2 List at least three use cases for virtualization? [1.5 Marks]

(0.5 marks for each use case)
Apple laptop running Mac OS X host, Windows as a guest
Developing apps for multiple OSes without having multiple systems
Testing applications without having multiple systems
Executing and managing compute environments within data centers

Question 4: [3 Marks]

1- What are system calls used for? **[1 Point]**.
System calls allow user-level processes [0.5] to request services of the operating system. [0.5]

2- Why do programs use high-level APIs instead of directly using system calls? **[1 Point]**.
- Program portability. [0.5]
- Easier to work with for application programmers. [0.5]

3- Which operating system uses Dalvik virtual machine, and what is the purpose of using it**? [1 Point]**
- Android [0.5]
- It is used to run android's executable files. [0.5]

Question 5: [3. Points]

1- To boot an operating system, a bootstrap loader is used in either a one-step process or a two-step process:

a) Where is the bootstrap loader stored in the one-step process? **[0.5 Points]**

Acceptable answers: ROM or EPROM or EEPROM [0.5]

b) What are the two steps in the two-step booting process, and what is the benefit of using a two-step process instead of a one-step process? **[1 Point]**

1- ROM code will load bootstrap program from a boot block stored in hard disk. [0.25]
2- Bootstrap program loads the OS from hard disk. [0.25]

This allows for easier modification and customization of the bootstrap program. [0.5]

2- Mach is an example of a microkernel OS structure:

a) Which operating system uses it as part of its kernel? **[0.5 points]**

Mac OS X [0.5]

b) Why is microkernel structure considered more reliable than monolithic structure? **[0.5 points]**

Acceptable answers: [0.5]

- Less code is running in kernel mode.
- Or, most services run as user processes. Therefore, if a service fail, it won't affect the rest of the OS.

c) What is a disadvantage of microkernel structure? **[0.5 points]**

Performance overhead due to user space to kernel space communication [message passing]. [0.5]