(1) Show the memory hierarchy.

![Memory Hierarchy Diagram]

(2) What is “page fault”?

A page fault is the situation when a particular virtual memory page requested by a processor is currently not mapped to any physical memory page.
(3) What are the three advantages in “virtual memory”? 

1. Eliminating the external memory fragmentation 
2. Programs that are larger than the physical memory capacity can be executed 
3. Using demand-paging, large programs can be started quicker (since the entire programs do not have to be loaded to the physical memory before they get executed by a processor) 

Note: “programs run faster” is a wrong concept (programs do NOT run faster. They only start quicker. Programs start more quickly, but after they start, they run more slowly). 

(4) What is “the internal memory fragmentation”? 

The internal memory fragmentation is the possible unused memory space in the last memory page assigned to a program, when the program size is not exactly a multiple of the page size. 

(5) What is “demand paging”? What is the primary advantage? 

The demand paging is a way physical memory pages are assigned to each program in the virtual memory. Using the on-demand paging, only the portions of a program that is necessary for a processor (to run the program) will be loaded to physical memory pages, meaning that any other portions of the program will not be loaded to physical memory pages until they are needed by a processor. 

There are a couple of different advantages in using on-demand programs: 

1. Programs (especially large ones) will start running more quickly. 
2. Programs that are larger than the physical memory capacity can be executed 
3. More programs than the capacity of the physical memory can actually hold can be active (can be executed at a time)