1. Which of the following is an example of a systems program?
   A) command interpreter                  C) text formatter
   B) Web browser                          D) database system
   Ans: A

2. If a program terminates abnormally, a dump of memory may be examined by a ____ to determine the cause of the problem.
   A) module    B) debugger    C) shell    D) control card
   Ans: B

3. A message passing model is ____.
   A) easier to implement than a shared memory model for intercomputer communication
   B) is faster than the shared memory model
   C) a network protocol and does not apply to operating systems
   D) is only useful for small simple operating systems
   Ans: A

4. Policy ____.
   A) determines how to do something
   B) determines what will be done
   C) is not likely to change across places
   D) is not likely to change over time
   Ans: B

5. The major difficulty in designing a layered operating system approach is ____.
   A) appropriately defining the various layers
   B) making sure that each layer hides certain data structures, hardware, and operations from higher-level layers
   C) debugging a particular layer
   D) making sure each layer is easily converted to modules
   Ans: A

6. A microkernel is a kernel ____.
   A) containing many components that are optimized to reduce resident memory size
   B) that is compressed before loading in order to reduce its resident memory size
   C) that is compiled to produce the smallest size possible when stored to disk
   D) that is stripped of all nonessential components
   Ans: D
7. Which of the following pieces of information is least useful to the SYSGEN program of an operating system?
   A) the CPU being used  
   B) amount of memory available  
   C) what applications to install  
   D) operating-system options such as buffer sizes or CPU scheduling algorithms  
   Ans: C

8. A boot block ____.
   A) typically only knows the location and length of the rest of the bootstrap program  
   B) typically is sophisticated enough to load the operating system and begin its execution  
   C) is composed of multiple disk blocks  
   D) is composed of multiple disk cylinders  
   Ans: A

9. In a virtual machine, each program believes that it has ____.
   A) multiple processors  
   B) its own memory  
   C) another "virtual" computer to assist in its operations  
   D) more memory than is physically available on the machine  
   Ans: B

10. ____ is a popular commercial application that abstracts Intel 80XXx86 hardware into isolated virtual machines.
    A) .NET  
    B) JIT  
    C) JVM  
    D) VMware  
    Ans: D

11. There are two different ways that commands can be processed by a command interpreter. One way is to allow the command interpreter to contain the code needed to execute the command. The other way is to implement the commands through system programs. Compare and contrast the two approaches.
    Ans: In the first approach, upon the user issuing a command, the interpreter jumps to the appropriate section of code, executes the command, and returns control back to the user. In the second approach, the interpreter loads the appropriate program into memory along with the appropriate arguments. The advantage of the first method is speed and overall simplicity. The disadvantage to this technique is that new commands require rewriting the interpreter program which, after a number of modifications, may get complicated, messy, or too large. The advantage to the second method is that new commands can be added without altering the command interpreter. The disadvantage is reduced speed and the clumsiness of passing parameters from the interpreter to the system program.
12. Describe the relationship between an API, the system-call interface, and the operating system.
   Ans: The system-call interface of a programming language serves as a link to system calls made available by the operating system. This interface intercepts function calls in the API and invokes the necessary system call within the operating system. Thus, most of the details of the operating-system interface are hidden from the programmer by the API and are managed by the run-time support library.

13. Describe three general methods used to pass parameters to the operating system during system calls.
   Ans: The simplest approach is to pass the parameters in registers. In some cases, there may be more parameters than registers. In these cases, the parameters are generally stored in a block, or table, of memory, and the address of the block is passed as a parameter in a register. Parameters can also be placed, or pushed, onto the stack by the program and popped off the stack by the operating system.

14. What are the advantages of using a higher-level language to implement an operating system?
   Ans: The code can be written faster, is more compact, and is easier to understand and debug. In addition, improvements in compiler technology will improve the generated code for the entire operating system by simple recompilation. Finally, an operating system is far easier to port - to move to some other hardware - if it is written in a higher-level language.

15. Describe some requirements, or goals, when designing an operating system.
   Ans: Requirements can be divided into user and system goals. Users desire a system that is convenient to use, easy to learn, and to use, reliable, safe, and fast. System goals are defined by those people who must design, create, maintain, and operate the system: The system should be easy to design, implement, and maintain; it should be flexible, reliable, error-free, and efficient.

16. What are the advantages and disadvantages of using a microkernel approach?
   Ans: One benefit of the microkernel approach is ease of extending the operating system. All new services are added to user space and consequently do not require modification of the kernel. The microkernel also provides more security and reliability, since most services are running as user - rather than kernel - processes. Unfortunately, microkernels can suffer from performance decreases due to increased system function overhead.
17. Explain why a modular kernel may be the best of the current operating system design techniques.
Ans: The modular approach combines the benefits of both the layered and microkernel design techniques. In a modular design, the kernel needs only to have the capability to perform the required functions and know how to communicate between modules. However, if more functionality is required in the kernel, then the user can dynamically load modules into the kernel. The kernel can have sections with well-defined, protected interfaces, a desirable property found in layered systems. More flexibility can be achieved by allowing the modules to communicate with one another.

18. Describe two approaches to provide direct sharing of resources in a virtual-machine concept.
Ans: First, it is possible to share a minidisk and thus to share files. This scheme is modeled after a physical shared disk but is implemented by software. Second, it is possible to define a network of virtual machines, each of which can send information over the virtual communications network. Again, the network is modeled after physical communication networks but is implemented in software.

19. In what ways does the JVM protect and manage memory?
Ans: After a class is loaded, the verifier checks that the .class file is valid Java bytecode and does not overflow or underflow the stack. It also ensures that the bytecode does not perform pointer arithmetic, which could provide illegal memory access. The JVM also automatically manages memory by performing garbage collection - the practice of reclaiming memory from objects no longer in use and returning it to the system.

20. What are two faster alternatives to implementing the JVM in software on top of a host operating system?
Ans: A faster software technique is to use a just-in-time (JIT) compiler. The first time a Java method is invoked, the bytecodes for the method are turned into native machine language for the host system, and then cached for subsequent invocations. A potentially faster technique is to run the JVM in hardware on a special Java chip that executes the Java bytecode operations as native code.

21. KDE and GNOME desktops are available under open-source licenses.
Ans: True

22. Many operating system merge I/O devices and files into a combined file because of the similarity of system calls for each.
Ans: True

23. The virtual-machine concept does not offer complete protection of the various system resources.
Ans: False
24. A program written for the .NET Framework need not worry about the specifics of the hardware or the operating system on which it will run.
   Ans: True

25. An initial bootstrap program is in the form of random-access memory (RAM).
   Ans: False