

Q15. Which of the following is a characteristic of an HA (High Availability) cluster configuration based on a hot standby method when it is compared to a load distribution cluster configuration that uses a load balancer?

- a) A server that has the same specifications is necessary as the secondary server, but since the secondary server takes over the processes in the event of the failure of the primary server, the throughput can be maintained even in the event of a failure.
- b) Given that processes are distributed to other operational servers in the event of a failure, the load on the servers in operation increases, and the throughput decreases.
- c) Given that processes can be distributed uniformly, server machines can be utilized effectively, and expandability is ensured, even if the amount of processing increases in the future.
- d) Given that processes must be consistent among multiple servers in operation, it is necessary to share a database.

- Q16.** Which of the following is the system configuration that has the highest availability? Here, when systems are connected in parallel, the systems are considered to be operational if at least one (1) of them is operating.
- a) A single system with an availability of 99%
 - b) Four (4) identical systems, each with an availability of 70%, are connected in parallel.
 - c) Three (3) identical systems, each with an availability of 80%, are connected in parallel.
 - d) Two (2) identical systems, each with an availability of 90%, are connected in parallel.

Q15. Which of the following is the appropriate description of RAID 5?

- a) Bit-level striping with a dedicated parity disk
- b) Block-level striping with a dedicated parity disk
- c) Block-level striping with distributed parity disks
- d) Byte-level striping with a dedicated parity disk

Q18. There exist methods to obtain backup files for the purpose of recovering files and managing generations. Which of the following is an appropriate description for those methods or procedures?

- a) A differential backup contains all files that are modified following the last full backup, while an incremental backup saves all files that are modified after the last full, differential, or incremental backup.
- b) A differential backup may take longer to restore files than an incremental backup, because the most recent versions of files are spread across a larger number of backup sets.
- c) A multiplexed backup is used as a mixed combination of a full backup, differential backup, and incremental backup.
- d) An incremental backup tends to take longer to backup files than a differential backup because more files are copied during each backup.

Q23. According to ISO 9241-11: 2018, which of the following is defined as the “extent to which a system, product, or service can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use”?

- | | |
|------------------|-----------------|
| a) Accessibility | b) Adaptability |
| c) Availability | d) Usability |

Q24. Which of the following is an explanation of clipping in 3D graphics processing?

- a) It is a process that applies shading to the surface of an object for a more 3D appearance.
- b) It is a process that defines a window within the image display area, removes the area outside the window, and cuts out the section visible within the window.
- c) It is a process that is performed in the last phase of CG video production and visualizes object data so that it can be rendered on the screen.
- d) It is a process to hide the jaggies that occur near the edge of a shape because of the limited number of pixels on the screen.

Q10. Which of the following is a technology that provides a dynamic user interface without page transition using an asynchronous communication in JavaScript?

- a) Ajax b) CSS c) RSS d) SNS

Q15. Which of the following is the RAID level where the entire stored data is lost when one of the multi-disks is damaged?

- a) RAID 0 b) RAID 1 c) RAID 5 d) RAID 6

Q14. In a web system, which of the following is an appropriate benefit of a web server and an application (AP) server being placed on different physical servers?

- a) Because the business logic that accompanies an access to data is placed in a program on the web server, the program on the AP server does not need to be changed in association with a change in the business logic.
- b) Because the difference between the character coding scheme of the web browser and that of the AP server is absorbed by the web server, garbled (or unreadable) characters do not appear.
- c) Because the execution environment of the client is implemented on the web server, the client and the AP server do not need to exchange screen data for each request, and only a small amount of data communication is required.
- d) Processing can be distributed according to the type of request from a client in such a way that a request for static content having a light load is processed by the web server, and a request for dynamic content having a heavy load is processed by the AP server.

Q15. Which of the following achieves data redundancy via mirroring?

- a) RAID 0
- b) RAID 1
- c) RAID 5
- d) RAID 6

Q23. Which of the following is an appropriate usage of radio buttons in GUI applications?

- a) To select multiple items from a group of items
- b) To select one item from a group of mutually exclusive items
- c) To select one item from a list or to enter new item into a text box
- d) To select one item from a list that is displayed when a button is pressed

Q24. Which of the following is a method of improving the appearance of a jagged edge of a slanted line to be smoothed on a screen, such as that of an LCD?

- a) Anti-aliasing
- b) Bump mapping
- c) Shading
- d) Texture mapping

Q13. As a backup system configuration, which of the following is an appropriate description of a hot site?

- a) A shared site is prepared, and at the time of the occurrence of a failure, the backed-up data and program are loaded to recover the system, and business operations are resumed.
- b) A site is operated as a standby site, the data and programs are updated at all times via a network, and the business operation is resumed immediately when a failure occurs.
- c) A spare site is secured beforehand, and at the time of the occurrence of a failure, the required hardware and the backed-up data and program are loaded to recover the system, and the business operation is resumed.
- d) Hardware is prepared at a spare site, and the periodically backed-up data and program are loaded and stored. At the time of occurrence of a failure, the system is restored by making use of these stored entities, and the business operation is resumed.

- Q14.** A RAID 6 server is configured with six hard disk drives, and each drive's capacity is one TB. What is the maximum total data storage capacity in TB? Here, spare disks are not used.
- a) 3 b) 4 c) 5 d) 6

Q15. The life cycle of a computer system can be classified from the viewpoint of failure into the three periods of early failure period, random failure period, and wear-out failure period. Which of the following is the most appropriate description of the measures in the early failure period?

- a) Implementing prior replacement of components
- b) Implementing scheduled maintenance and condition-based maintenance
- c) Performing age-based maintenance on the basis of the cumulative operating time of the items that make up the system
- d) Strengthening the design review and failure analysis in order to reduce errors in the design and manufacturing

Q24. Among GUI components, which of the following is an appropriate use of a radio button?

- a) To select one item from a list of items or type a new item in a text box
- b) To select one item from a list of items that appears when activated
- c) To select one item from a group of mutually exclusive items
- d) To select one or more items from a group of items

Q14. When two computers have been prepared, and the computer in use fails, which of the following is the system that continues processing by promptly switching to the backup computer that has started the same online processing programs as those on the currently-used computer in advance, and is on standby?

- a) Cold standby system
- b) Hot standby system
- c) Multiprocessor system
- d) Multiuser system

Q15. Which of the following is essential to realizing a fault-tolerant system?

- a) Automatically recording the history, such as information about changes to the database, while the system is in operation in order to investigate causes of system failure and restore the system in the event of a system failure
- b) Designing for easy operations so that operational errors do not occur easily, or designing operations in such a way that even if an operational error occurs, it does not result in a fatal error
- c) Periodically taking a data backup so that the status prior to the failure can be restored to a reserve environment without delay in the event of a failure
- d) Providing redundancy in the system configuration to minimize the impact from any failure of parts so that processing can be continued without affecting the overall system

Q26. Which of the following is the most appropriate explanation of augmented reality (AR)?

- a) By appealing to the five senses through equipment, such as a head-mounted display, a person can experience locations or worlds that do not actually exist as if they were real.
- b) By constructing a 3D virtual space that is natural to humans, and changing the virtual space in accordance with a person's movement, he or she can feel as if he or she is in that place.
- c) By seamlessly interweaving a computer-generated information with the physical world, the viewer can perceive it as an immersive aspect of the real environment.
- d) By viewing a video recorded in the past, the viewer can feel as if he or she were in that era and at that location.

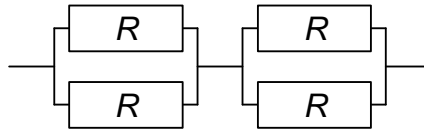
Q13. Which of the following is an appropriate description concerning the recording method of RAID5?

- a) It distributes the data over multiple hard disk drives, writes the data in units of bits, and writes the ECC (Error Correction Codes) on multiple hard disk drives.
- b) It distributes the data over multiple hard disk drives, writes the data in units of blocks, and distributes and writes the parity on multiple hard disk drives.
- c) It distributes the data over multiple hard disk drives, writes the data in units of bytes, and writes the parity on one (1) hard disk drive.
- d) It writes the same data on two (2) hard disk drives to create a mirror disk.

Q14. Which of the following is the most appropriate description of a dual system?

- a) It loads the online processing program of the active system on to a backup system and sets it to a standby status. In the event of a failure in the active system, it immediately switches to the backup system and continues the processing.
- b) It prepares a duplicate processor, memory, communication channel, and power supply system and continues the processing even in the event of a failure in any of the devices.
- c) It provides a duplicate system for performing the same processing and checks the accuracy of the processing by collating the processing results. In the event of a failure in either system, it continues the processing by the degraded operation.
- d) It provides an active system for performing online processing and keeps a backup system on standby while batch processing is being performed. In the event of a failure in the active system, it switches to the backup system and continues the online processing.

Q15. A system has devices with availability R , connected as shown in the figure below. Which of the following is the expression that represents the availability of the entire system? Here, a parallel connection only requires either of the two devices to be functional, whereas a series connection requires both the devices to be functional.



a) $(1 - (1 - R)^2)^2$

b) $(1 - (1 - R^2))^2$

c) $1 - (1 - R)^4$

d) $1 - (1 - R^2)^2$

Q25. In 3D computer graphics, which of the following is an explanation of hidden-line removal or hidden-surface removal in rendering?

- a) By analyzing the position of the light source and how much light hits the target object, its color and brightness are determined.
- b) For the generated image, only the portion that fits the computer display is rendered.
- c) For the target object, only the portion that is viewable from a specified viewpoint is rendered.
- d) Using a wireframe model with translucency, not only the surface but also the inside of the target object is rendered.

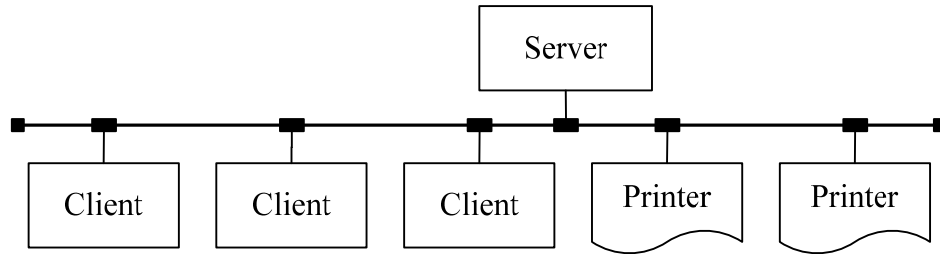
Q14. Which of the following is an appropriate description of the effect of cache memory?

- a) By reading data from main memory and storing it in cache memory, and then processing instructions in parallel in cache memory, operations are performed at high speed.
- b) By reading data from main memory and storing it in cache memory, data transfer is performed at high speed when the CPU reads the same data later.
- c) By reading instructions and data simultaneously from main memory to cache memory, data transfer is performed at high speed.
- d) By reading instructions from main memory and storing them in cache memory, and then decoding and executing them in cache memory, operations are performed at high speed.

Q15. Which of the following is an appropriate explanation of a benchmark test?

- a) It evaluates the performance by analyzing the system processing theoretically and estimating the processing time from the number of occurrences and predicted number of executions of individual instructions, rather than actually executing a program.
- b) It evaluates the system performance by using a program in which a model is created and simulated for the purpose of evaluation with the inclusion of future estimates.
- c) It executes a standard program selected in accordance with the usage purpose, and measures the system's processing performance.
- d) It measures the operating condition of a system and the status of resources using a program for monitoring and measuring, and obtains data on the system configuration and response performance.

Q16. As shown in the figure below, one (1) server, three (3) clients, and two (2) printers are connected via a LAN. This system prints data located on the server in response to instructions from the clients. When the availability of each device is as shown in the table below, which of the following is the expression that represents the availability of the system? Here, the system is considered available when the server, one (1) of the three (3) clients, and one (1) of the two (2) printers are running.



Device	Availability
Server	a
Client	b
Printer	c
LAN	1

a) ab^3c^2

b) $a(1 - b^3)(1 - c^2)$

c) $a(1 - b)^3(1 - c)^2$

d) $a(1 - (1 - b)^3)(1 - (1 - c)^2)$

Q13. Which of the following is a method that increases the speed of data input/output by dividing logically sequential data and writing the divided data into multiple hard disks?

- a) Disk cache
- b) Mirroring
- c) Striping
- d) Swapping

- Q14.** Which of the following is a characteristic of a HA (High Availability) cluster configuration based on a hot standby method when it is compared to a load distribution cluster configuration that uses a load balancer?
- a) A server that has the same specifications is necessary as a secondary server, but since processes are taken over by the secondary server in the event of the primary failure, the throughput can be maintained even in the event of a failure.
 - b) Given that processes are distributed to other servers in operation in the event of a failure, the load of servers in operation increases and the throughput decreases.
 - c) Given that processes can be distributed uniformly, server machines can be utilized effectively and expandability is ensured even if the amount of processing increases in the future.
 - d) Given that processes must be consistent among multiple servers in operation, it is necessary to share a database.

Q15. Which of the following is an appropriate description concerning system availability?

- a) Even if the MTBF is different, the system availability is equal if the MTTR is equal.
- b) If the MTTR can be shortened without changing the MTBF, the system availability improves.
- c) If the MTTR does not change and the MTBF increases, the system availability deteriorates.
- d) If the sum of the MTBF and the MTTR is equal, the system availability is equal.

Q25. Which of the following is a process in PCM to capture analog values from audio signals at a regular interval?

- a) Encoding b) Reverse quantization c) Quantization d) Sampling

Q9. Which of the following is an appropriate explanation of symmetric multiprocessing (SMP)?

- a) One CPU core serves as a master, while the other CPU cores act as slaves and perform the tasks assigned to them by the master.
- b) One or more programs are loaded in the main memory, and only one program at a time is able to get the CPU for the execution while all the others are waiting their turns.
- c) Several CPU cores have schedules for their own tasks, with priorities set by the operating system with equal access to the memory and system resources.
- d) While one stage of an instruction is being processed, other instructions may be processed at a different stage so that multiple instructions can be processed at the same time.

Q13. Which of the following is the RAID level that can recover data from the other disks, with a minimum of two-disk configuration?

a) RAID 0

b) RAID 1

c) RAID 5

d) RAID 6

Q15. Which of the following is an appropriate characteristic of a web system implemented in a three-layer client/server system configuration?

- a) A business process is executed on the server side, and the client software displays the result on a screen according to the HTML coding.
- b) A program coded in HTML is run on the server side, and the client software displays the result on a screen.
- c) Every time a business process is changed, a business process application for operating the web system must be sent and installed on the client terminal.
- d) On the client terminal, it is necessary to have a resident service program waiting to receive an HTTP request from the server side.

Q15. Which of the following is the most appropriate explanation of grid computing?

- a) A computing task is distributed to several computers in the network to attain the computational capacity.
- b) Physical devices such as computers or network devices are emulated to circumvent compatibility constraints and attain software portability and flexibility.
- c) Requirements are stated as constraints on response time and/or on the temporal validity of sensory data.
- d) Sensing devices are connected to a network to provide feedback and control through personal mobile devices.

Q17. Which of the following is an appropriate description concerning MTBF and MTTR?

- a) MTBF of a system decreases and MTTR of a system increases through remote maintenance.
- b) MTBF of a system increases as the number of device types that constitutes the system increases.
- c) MTBF of a system increases through preventive maintenance.
- d) MTTR increases because of functions such as an error log or an instruction trace.

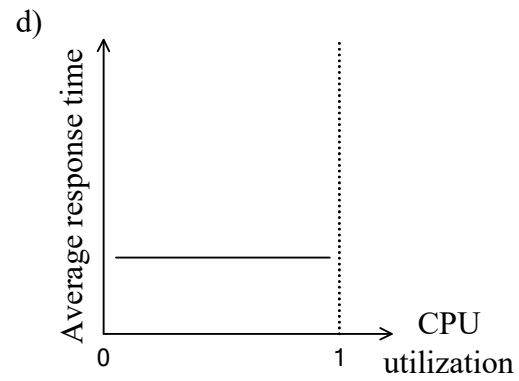
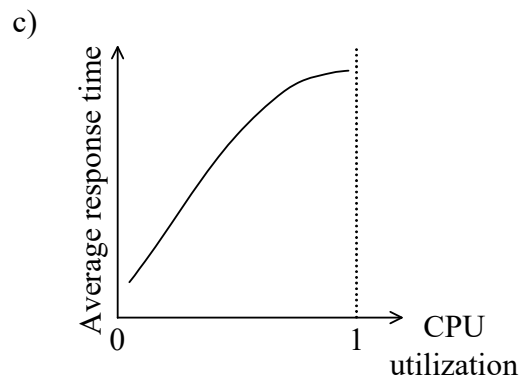
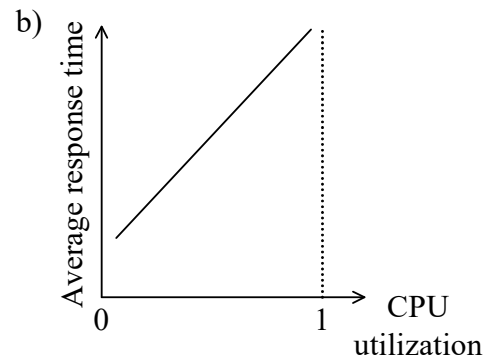
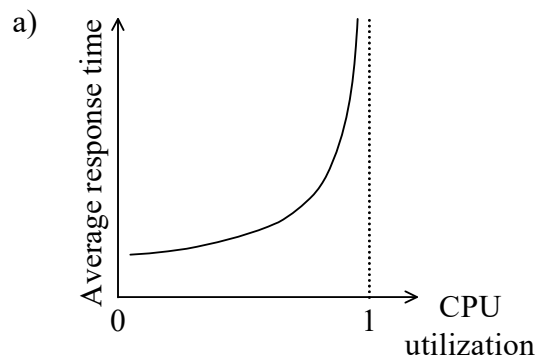
Q26. Which of the following is an appropriate explanation of clipping in 3D graphics processing?

- a) It is a method to selectively enable or disable rendering operations within a defined region of interest.
- b) It is a process of altering the colors of an object based on the angle of the surface to the light sources to produce a photorealistic effect.
- c) It is a technique to reduce the prominence of jaggies by surrounding the stair steps of edge lines with intermediate colors.
- d) It is the last phase of CG production to render the object data to be visualized on the screen.

Q13. Which of the following is an appropriate description of the reliability of computer systems?

- a) As the system configuration becomes more complicated, MTBF increases.
- b) Availability of systems can be improved by increasing MTTR and MTBF.
- c) Preventive maintenance of systems is performed to increase MTBF.
- d) Remote maintenance of systems can increase MTTR and improve availability.

Q15. Which of the following is an appropriate graph that shows the relationship between CPU utilization and average response time in an online real-time system? Here, transactions occur according to a Poisson distribution, and the processing time for a transaction follows an exponential distribution.



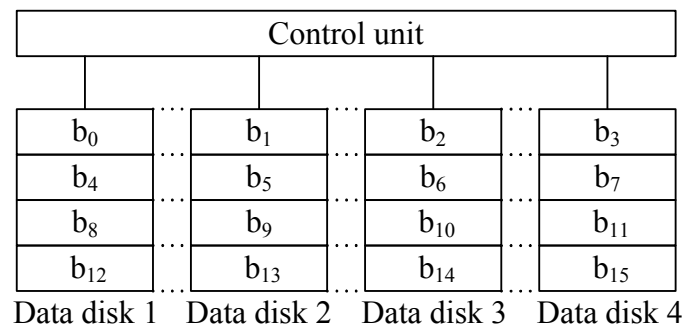
Q24. Which of the following shows the path information from the front page of a web site to the current page, a user is currently viewing?

- a) Breadcrumbs
- b) Navigation bar
- c) Scroll bar
- d) Site map

Q25. Which of the following is an explanation of the morphing technique in computer animation?

- a) A hand-drawn outline is read with a scanner, then each enclosed area is filled with a single color.
- b) Based on the digital data collected from the actual movement of a body, multiple images with a realistic movement are created.
- c) In order to make a perspective two-dimensional animation, each image of moving parts is superposed on the background one by one in descending order of its distance from the viewer.
- d) In order to represent a smooth transition between two images, multiple intermediate images are created for interpolation.

Q16. Which of the following is a technique of segmenting and storing data on multiple hard disks as shown in the figure? Here, b_0 through b_{15} show the sequence in which the data are stored to the data disks on a bit-by-bit basis.



- a) Blocking
- b) Disk cache
- c) Mirroring
- d) Striping

Q17. Which of the following is an appropriate description of throughput?

- a) Even if some idle time resulting from operator intervention between the end of a job and the start of the next job occurs in a system, throughput is not affected.
- b) Multi-programming contributes to reducing turnaround time, but is not useful in improving throughput.
- c) Spooling, which involves temporarily saving the output to a printer in a hard disk, is useful in improving throughput.
- d) Throughput is an index of CPU performance and is not affected by the I/O speed, overhead time, and other such factors.

Q28. Which of the following is an explanation of texture mapping?

- a) It is a process by which surfaces that should not be visible to the user are prevented from being rendered.
- b) It renders a scene by calculating reflection, refraction, and transparency from the light source.
- c) It renders shadows based on light sources and shapes of objects when a scene is realized.
- d) It represents surface characteristics by pasting an image onto the surface of a three-dimensional object.

Q14. Which of the following is the concept of a fail-safe design?

- a) When a failure occurs in a leased line, switching to a public line occurs immediately, and the processing continues even though the processing efficiency of the system declines.
- b) When a failure occurs in the data transfer process of a data collecting system, only the data input process is performed, and all the data is transmitted at the time of recovery from the failure.
- c) When anything other than a numeric character is entered in the numeric input field, the system issues a warning message and requests a correct input.
- d) When the system determines that there is a fault in the sensor for detecting if someone has entered the working envelope or work area, the robot arm is stopped forcibly.

Q15. Which of the following is an appropriate description concerning the reliability of a computer system?

- a) As the system configuration becomes more complicated, MTBF (Mean Time Between Failures) increases.
- b) Availability of systems can be improved by increasing MTTR (Mean Time To Repair) and MTBF.
- c) Preventive maintenance of systems is performed to increase MTBF.
- d) Remote maintenance of systems can increase MTTR and improve availability.

Q25. In the process of creating animation, which of the following is used to incorporate the natural movement of objects, humans and animals, by using sensors and video cameras?

- a) Key frame method
- b) Morphing
- c) Motion capture
- d) Pixel shader

Q13. Which of the following is an appropriate purpose of the parity check of a memory module?

- a) To detect and correct an error automatically during reading
- b) To detect the occurrence of an error during reading
- c) To determine whether power is supplied to the memory module
- d) To encrypt the data read out from the memory module

Q15. Which of the following is the most appropriate method for the implementation of a fault tolerant system?

- a) A fault tolerant system is not implemented by using hardware, but rather by using software.
- b) Devices and equipment are not dual-redundant, but important processes are performed on devices with high availability.
- c) The system is multiplexed with two or more computers instead of using a single computer.
- d) The system is not implemented in a fail-soft configuration, but rather in a fail-safe configuration.

Q16. Which of the following is the most appropriate explanation of a benchmark test for a computer system?

- a) It is determined whether or not the system has a tolerance to handle the expected number of transactions.
- b) The performance of a system is measured from the average time required to execute a single instruction.
- c) The processing performance of a system is compared with other systems in terms of scores obtained by executing software for measurement.
- d) The proportion of continuous operation time of a system is measured and compared with other systems.

Q26. Which of the following is the function of a human interface that is used for reducing the number of operations of a user who frequently performs routine work?

- a) A function for displaying the input errors altogether on the last screen
- b) A function for displaying which process is reached from among all processes
- c) A function for enabling return to the previous state if an operation is wrong
- d) A macro function by which a series of commands is grouped together

Q27. Which of the following is a tag-based very flexible image file format that can be lossless or lossy, and is widely used for the interchange of digital image data among graphic artists, photographers, and the publishing industry?

- a) JPEG b) GIF c) PNG d) TIFF

Q13. Among the RAID systems, which of the following should be used in cases where maximum storage capacity is required but data redundancy or fault tolerance is not a requirement?

- a) RAID 0 b) RAID 1 c) RAID 5 d) RAID 6

Q14. Which of the following is an appropriate explanation concerning a fault tolerant system?

- a) A system that consists of multiple processors connected through a network and shares resources located in the network
- b) A system that has a backup system at a remote location in preparation for the occurrence of a local disaster or other accident
- c) A system that is designed so that the functions required for the overall system can continue to operate even in the event of a partial failure
- d) A system that processes a single transaction in parallel by using multiple processors and verifies the results by cross-checking

Q24. A shop sells approximately 200 types of products. Among the input items for a new product on the registration screen, which of the following is the input item that is suitable for using a pull-down menu as an input method?

	Input item	Format and rules
a)	Product number	Each product number consists of five numeric characters.
b)	Product name	Each product name consists of 40 or fewer alphanumeric characters.
c)	Product category	There are five categories, and each category consists of 10 or fewer alphanumeric characters.
d)	Price	Each price has a 3- or 4-digit numeric value with a range from 100 to 1,000 dollars.

Q25. Which of the following is an explanation concerning the morphing technique in computer animation?

- a) A hand-drawn outline is read with a scanner, and a single particular color is applied to its enclosed area.
- b) A two-dimensional animation with a sense of depth is generated, independently of the background, by creating and superimposing multiple images with parts involving movement in descending order of distance from the viewer.
- c) In order to represent the smooth transformation in appearance from an image to another image, multiple intermediate images are created.
- d) The actual movement of a body is collected as digital data, and on the basis of such data, multiple images with realistic movement are created.

Q21. Which of the following is a term that shows the amount of work that is processed per unit of time by a computer system?

- a) Response time
- b) Throughput
- c) Time slice
- d) Turnaround time

Q22. Which of the following is the most appropriate explanation of a dual system?

- a) It loads the online processing program of the currently used system onto the backup system that is set to the standby state. In the event of a failure in the currently used system, it immediately switches to the backup system and continues the processing.
- b) It prepares a dual-redundant unit or device, such as processor, memory, channel, and power supply, and continues the processing even in the event of a failure in either of the devices.
- c) It provides a currently used system for performing online processing and also a backup system that is made to wait while performing the batch processing. In the event of a failure in the currently used system, it switches to the backup system and continues the online processing.
- d) It provides a duplicate system for performing the same processing, and performs a cross check of the processing results. In the event of a failure in either system, it continues the processing through degraded operation.

Q26. Which of the following is an appropriate reason for using a real-time OS in an embedded system?

- a) A graphical user interface is provided from an ease-of-use perspective.
- b) No data is lost even if an application program hangs up.
- c) The highest level of system security and reliability is assured.
- d) There is a mechanism available to respond within the limited time.

- Q17.** Which of the following is a technique of dividing the data of each file into blocks of a fixed size, distributing and deploying those data blocks on multiple hard disks that can be accessed in parallel, and thereby improving the file access speed?
- a) Disk cache
 - b) Disk mirroring
 - c) Disk striping
 - d) Disk-at-once

Q18. Which of the following is an appropriate characteristic of a Web system that is implemented using the configuration of a three-tier client/server system?

- a) A business process is executed on the server side, and the client software displays the result on a screen according to the HTML coding.
- b) A program written in HTML is run on the server side, and the client software displays the result on a screen.
- c) It is necessary for the client terminals to have a resident service waiting to receive an HTTP request from the server side.
- d) Whenever a business process is changed, a business application for operating the Web system must be distributed and installed on the client terminals.

Q19. Which of the following is the appropriate combination of indexes or indicators concerning RAS (Reliability, Availability, and Serviceability)?

	Reliability	Availability	Serviceability
a)	MTBF	MTTR	$\frac{\text{MTBF}}{\text{MTBF} + \text{MTTR}}$
b)	MTBF	$\frac{\text{MTBF}}{\text{MTBF} + \text{MTTR}}$	MTTR
c)	MTTR	$\frac{\text{MTBF}}{\text{MTBF} + \text{MTTR}}$	MTBF
d)	$\frac{\text{MTBF}}{\text{MTBF} + \text{MTTR}}$	MTBF	MTTR

Q20. Which of the following is an appropriate expression for calculating the server processing time T_s when the response time T_r , line transmission time T_l , and client processing time T_p can be measured at the client side for one transaction of the online real time processing? Here, all other overheads are ignored.

a) $T_s = T_r + T_l + T_p$

b) $T_s = T_r + T_l - T_p$

c) $T_s = T_r - T_l + T_p$

d) $T_s = T_r - T_l - T_p$

Q24. Which of the following is an appropriate explanation of a benchmark test for computer systems?

- a) The operating state of each system and the status of resources are measured by a monitoring and calculation program, and data on system configuration and response performance is obtained.
- b) The relative processing power of each system is measured and evaluated by executing a computer program, a set of programs, or other operations selected in accordance with the purpose of usage.
- c) When evaluation is performed with the inclusion of the future estimates, the performance of each system is evaluated using a program that is tested in a simulated manner by creating a model.
- d) Without executing a program, the processing of each system is analyzed theoretically, and the processing time is estimated from the predicted value of the occurrence frequency and execution frequency of each instruction to evaluate the performance.

Q30. According to ISO 9241-210: 2010, which of the following is defined as the “extent to which a system, product, or service can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use”?

- | | |
|------------------|-----------------|
| a) Accessibility | b) Adaptability |
| c) Availability | d) Usability |

Q31. Which of the following is an explanation of clipping in 3D graphics processing?

- a) It is the process of defining a window within an image display area and removing objects or parts of objects that lie outside the window.
- b) It is the process of imaging the data of an object in the final stage of CG image creation so that the data can be rendered on the display.
- c) It is the process of pasting a pattern on the surface of a modeled object for achieving realism in computer graphics..
- d) It is the process of shading the surface of an object to provide a three-dimensional appearance.

Q16. Which of the following is the most appropriate explanation of cloud computing?

- a) It accumulates the computational capacity of several PCs so that a computational capacity of the same level as a supercomputer can be achieved.
- b) It connects all electric appliances to a network as intelligent products so that these devices can be monitored and operated at any time and from any place.
- c) It enables PCs on a network to communicate with each other based on an equal relationship, without the use of a specific server.
- d) It provides the resources of a computer via a network so that the user can easily receive services with high scalability and availability.

Q17. Which of the following is an essential activity for achieving a fault tolerant system?

- a) Automatically recording the history, such as the change information of the database, during the system operation in order to perform cause analysis and recovery when a failure occurs in the system
- b) Designing simple operations in which operational errors do not occur easily, or designing an operation in such a way that even if an operational error occurs, it does not result in a fatal error
- c) Providing redundancy for a system configuration to minimize the effect of a component failure so that the processing can be continued without any effect on the overall system
- d) Taking a data backup periodically so that after the occurrence of a failure the state prior to the failure can be restored promptly in an alternate system environment

Q18. In reliability design, which of the following is an appropriate example of fail-soft?

- a) In a system with a cluster configuration, even when a server does not work, another server takes over applications and provides functions.
- b) In order not to lose data even when an application is shut down by mistake, the application regularly saves a copy of data on a storage device during editing.
- c) In order not to stop a system because of partial functional failures, the system is composed only of hardware and software that are fully verified and highly reliable.
- d) On the input screen of a reception system that requires an e-mail reply, two input fields for the e-mail address are provided and checked to see if they are the same.

Q19. Which of the following is an appropriate description concerning MTBF and MTTR?

- a) MTBF increases as the number of device types that constitute the system increases.
- b) MTBF increases through the preventive maintenance of a system.
- c) MTTR increases and MTBF decreases through the remote maintenance of a system.
- d) MTTR increases owing to functions such as an error log or an instruction trace.

Q30. Among the descriptions concerning three-dimensional computer graphics, which of the following is an explanation of polygon?

- a) It is a basic element that is used for constituting a polyhedron taking the form of a closed solid or for approximating a quadric surface or a free-form surface.
- b) It is a basic element, such as a pattern or design, which is pasted on the surface of a modeled object.
- c) It is an image obtained by converting a model recorded inside a computer to a two-dimensional form so that it can be rendered on the screen.
- d) It is an image that transforms smoothly from an image a including an object A to an image b including a different object B having another shape.

Q16. Among the descriptions of computer system architecture, which of the following is an explanation of a tightly coupled multiprocessor system?

- a) Multiple processors share the same hard disk, and each processor is controlled by its own independent OS. The throughput is increased by distributing the load on a per job basis.
- b) Multiple processors share the same main memory and are controlled by a single OS. In principle, a task in the system can be executed on any of the processors, so the throughput is increased by distributing the load in small pieces.
- c) One processor is normally on standby. When there is a problem with the primary processor that is in full operation, processing continues by switching over to the standby processor.
- d) Two processors connected in parallel perform the same process simultaneously, and their results are cross-checked. If one processor fails, that processor is disconnected and processing continues on the other processor.

Q20. Which of the following is an appropriate description concerning a hot site prepared as a backup system?

- a) A reserved site is prepared in advance, and the necessary hardware and the media storing backup data and programs are delivered to the site so as to resume business operations in the event of a failure.
- b) A shared site is prepared, and the media storing backup data and programs are delivered to the site so as to restore the system and resume business operations in the event of a failure.
- c) A site is put into operation as a standby site, and its data and programs are constantly updated via the network so as to resume business operations quickly in the event of a failure.
- d) Hardware is prepared in a reserved site, and the media containing backup data and programs are periodically sent to the site for storage so as to restore the system and resume business operations by using these backup media in the event of a failure.

Q21. Among the descriptions of the reliability design of a system, which of the following is an appropriate example that uses a foolproof approach rather than a fail-safe approach?

- a) A design of a dual redundant system that makes it possible to continue system operations by disconnecting a failed unit if it is either of the duplicated units
- b) A design of an operational system that incorporates scheduled maintenance of equipment in order to prevent the occurrence of a fault
- c) A design that checks to ensure proper operation in order to prevent an operator from making a mistake because of improper use
- d) A design that reduces or minimizes the effect of a malfunction or failure that occurs in any part of the system

Q22. Which of the following is an appropriate characteristic of a thin client system?

- a) A business system mainly for data usage can be easily implemented such that the necessary application is automatically started by simply inserting a USB memory stick which stores the business data.
- b) It can reduce the risk of exposure to threats, such as viruses, by protecting the server in a system where the client has no external storage device.
- c) It improves the scalability of a system; for example, it allows the latest peripheral devices to be connected to the client anytime by using the client that is equipped with only USB interface for peripherals.
- d) It is a system in which a cell phone equipped with GPS is used as a terminal, and can be used for detecting the user's location as well as for data entry and display.

Q32. Which of the following is the image processing technique that is used for smoothing the jagged edges of curved or diagonal lines caused by poor resolution on a display screen?

- a) Anti-aliasing
- b) Morphing
- c) Ray tracing
- d) Texture mapping

Q17. Which of the following is the appropriate RAID configuration that provides byte-level striping in combination with parity information and stores the parity for each stripe in a dedicated disk?

- a) RAID1 b) RAID2 c) RAID3 d) RAID4

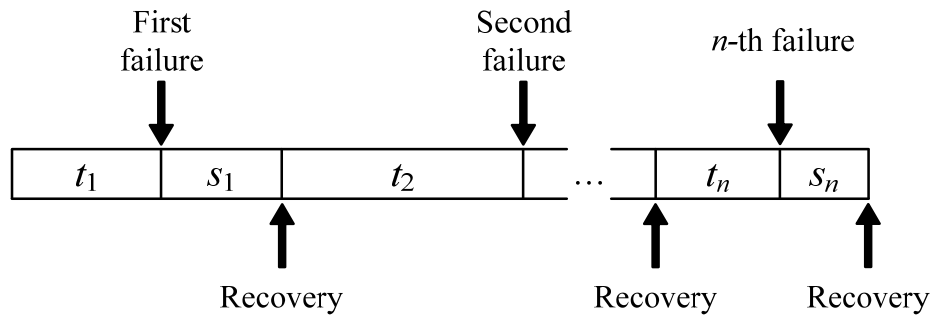
Q18. Which of the following is the configuration of distributed system where hierarchical or dependency relations exist between processors as with relationships between clients and servers?

- a) Horizontal function distribution
- b) Horizontal load distribution
- c) Vertical function distribution
- d) Vertical load distribution

Q19. Which of the following is a framework or methodology of dividing the resources of a computer into multiple execution environments, by applying one or more concepts or technologies such as hardware and software partitioning, time-sharing, partial or complete machine simulation, emulation, quality of service, and many others?

- a) Clustering
- b) Distribution
- c) Load balancing
- d) Virtualization

Q20. A system fails and recovers repeatedly over time, as shown in the figure below. Which of the following is the appropriate combination of the indicators or indexes that represent reliability and availability in RASIS? Here, $T = \frac{1}{n} \sum_{i=1}^n t_i$ and $S = \frac{1}{n} \sum_{i=1}^n s_i$.



	Reliability	Availability
a)	T	
b)	T	$T/(T+S)$
c)	$T+S$	S
d)	$T+S$	$T/(T+S)$

Q30. According to ISO 9241-11, usability is defined as the “extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use.” Which of the following is an appropriate method for evaluating the “level of user satisfaction” mentioned in this definition?

- a) Cluster analysis method
- b) Heuristic evaluation method
- c) Interview method
- d) Log data analysis method

Q31. Which of the following is an appropriate example of VR (Virtual Reality)?

- a) A history teacher makes use of software to present a 3D image of ancient Rome that can be navigated by students to simulate walking through the entire city by using a mouse or a keyboard.
- b) Computer games and simulations make use of multimodal devices, such as a wired glove, a headgear, and an omni-directional treadmill, in order to provide very enriching and life-like experience for the user.
- c) GPS maps combined with layers of satellite images and GIS information provide accurate or close to accurate topographical information for researchers.
- d) Military aircraft equip pilots with headgear that provides heads-up display to combine maps, topographical information, battle ground feedback from various devices such as sensors and satellites.

Q15. Which of the following is an appropriate characteristic of a client/server system?

- a) A tightly-coupled system configuration is employed so that both client and server can work well together to access common resources.
- b) Databases installed within clients that provide services can be flexibly expanded with a change in the scale.
- c) The client works together with servers in order to provide services in response to many requests from servers.
- d) The server provides functions as services for the client and performs the intended application in cooperation with the client.

Q17. Which of the following is the appropriate RAID configuration that provides disk striping at the block level rather than byte level and reserves one disk for parity information?

- a) RAID1 b) RAID2 c) RAID3 d) RAID4

Q28. When a GUI screen is designed for both users who are familiar with keyboard operation and users who are not, which of the following is an appropriate consideration to implement a user interface with good usability?

- a) Both mouse and keyboard interfaces should be provided for as many operations as possible, in order to increase operational flexibility.
- b) Frequently used operations should be executed by double-clicking a mouse button in lieu of an equivalent keyboard action.
- c) Important items, such as mandatory items, should be grouped together irrespective of the format of the data entry sheet, so as not to cause a lack of input.
- d) The number of items for keyboard entry should be minimized, and as many items as possible should be selected from the list by using a mouse, not a keyboard.

Q29. Which of the following is the image processing technique that is used for pasting a two-dimensional image such as a pattern or design onto the surface of a modeled object?

- a) Anti-aliasing
- b) Blending
- c) Ray tracing
- d) Texture mapping

Q18. Which of the following is the most appropriate term to represent a pay-per-use model for enabling available, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, services) that can be rapidly provisioned and released with minimal management effort or service provider interaction?

- a) Cloud computing
- b) Context aware computing
- c) Grid computing
- d) Social computing

Q19. Which of the following is an appropriate explanation of a fault tolerant system?

- a) It is a backup system provisioned at a remote site as preparation for a regional disaster.
- b) It is a system that continues providing functions required for system operations as a whole even if a part of the system fails to operate properly.
- c) It is a system that processes one transaction with multiple processors in parallel and checks the results.
- d) It is a system that shares resources by connecting multiple processors via a network.

Q20. Among indicators of RAS used for evaluating the level of system reliability, which of the following is a measure of availability?

a) $\frac{\text{MTBF}}{\text{MTBF} + \text{MTTR}}$

b) $\text{MTBF} + \text{MTTR}$

c) MTBF

d) MTTR

Q21. Air brake systems are provided for railway trains, trucks, etc. Loss of air for any reason automatically applies the brakes and brings the vehicle to a stop. Which of the following is the most appropriate term that means this capability?

- a) Fail-over b) Fail-proof c) Fail-safe d) Fail-soft

Q23. Which of the following is the reason for using a real-time OS with a hard real-time control system such as engine control and hard disk control?

- a) A mechanism that completes the processing for each event within a specified time is necessary.
- b) A mechanism that improves the throughput of the entire system is necessary.
- c) A mechanism that runs multiple independent programs concurrently is necessary.
- d) A memory protection mechanism to prevent virus intrusion is necessary.

Q28. From viewpoints of not only home users but also professional or experienced users, which of the following is the most appropriate GUI component that should be used for entering date of birth (four-digit year, two-digit month, and two-digit day) in three separate fields on the screen?

- a) Check box
- b) Combo box
- c) Drop-down list
- d) Radio button

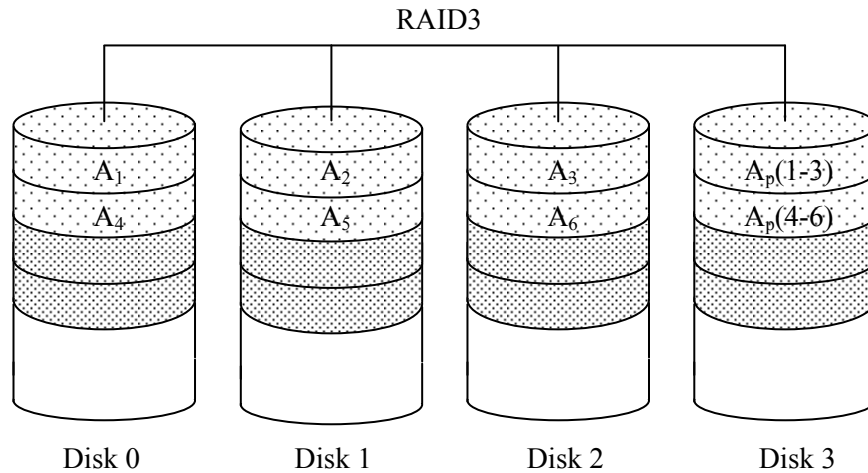
Q17. Which of the following is an appropriate explanation of TCO?

- a) Total cost required for system development
- b) Total cost required for system installation
- c) Total cost required for the initial investment of a system
- d) Total cost required throughout the life cycle of a system

Q18. In the RAID3 system shown below, three disks (Disks 0 through 2) for byte-striped data and one dedicated parity disk (Disk 3) are used as one volume. Parity byte A_p is generated by calculating the “exclusive OR” (\oplus) of three bytes in Disks 0 through 2. For example, $A_p(1-3)$ is calculated as follows:

$$A_p(1-3) = A_1 \oplus A_2 \oplus A_3$$

In the event of a disk failure, data recovery can be accomplished by using the information recorded on the remaining three error-free disks. Which of the following operations should be executed for this data recovery?



- a) AND
- b) Exclusive NOR
- c) Exclusive OR
- d) OR

Q19. Backup sites, which are used during system downtime, are classified into three types: warm, cold, and hot sites. In general, which of the following is the list arranged in order from shortest to longest recovery time?

- a) Cold site, warm site, hot site
- b) Hot site, warm site, cold site
- c) Warm site, cold site, hot site
- d) Warm site, hot site, cold site

Q20. Which of the following is the appropriate explanation of throughput?

- a) It is the elapsed time after a job is submitted to the system until the final result is returned. It is affected by the I/O speed, overhead time, etc.
- b) It is the maximum number of concurrently executable jobs. It depends on the resources of the system that can be used.
- c) It is the number of jobs processed per unit time. Spooling helps to improve throughput.
- d) It is the operating rate of a job, which can be calculated by the expression “running time of the job \div operations time”.

Q21. In an online transaction system environment, which of the following represents the interval of time from the time the system completes receipt of an input to the time the system begins to return its resulting output?

- | | |
|------------------|--------------------|
| a) Access time | b) Latency time |
| c) Response time | d) Turnaround time |

Q28. Which of the following is an appropriate explanation of SoC (System on a Chip)?

- a) A semiconductor chip equipped with a set of circuits which manages the data exchanged between devices, such as CPU, memory, or peripherals
- b) A semiconductor chip in which all required functions (systems) are integrated in the same manufacturing process
- c) A semiconductor chip in which functions with different processes are manufactured in separately optimized processes and each chip is appropriately wired on a package
- d) An electronic circuit board used for computers composed of CPU, chipset, video chip, memory, etc.

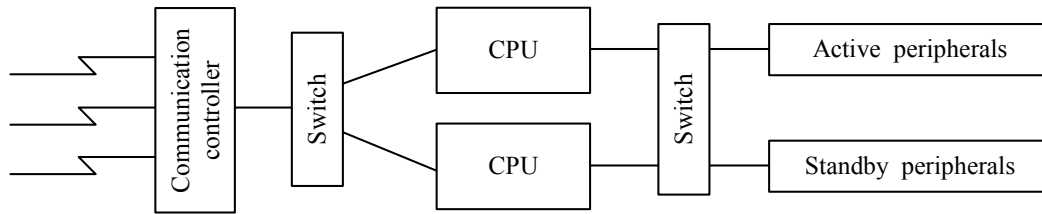
Q29. Which of the following is a user interface that enables frequently-used operations to be performed efficiently?

- a) Online help
- b) Progress bar
- c) Shortcut key
- d) Undo function

Q19. Which of the following is the most appropriate explanation of grid computing?

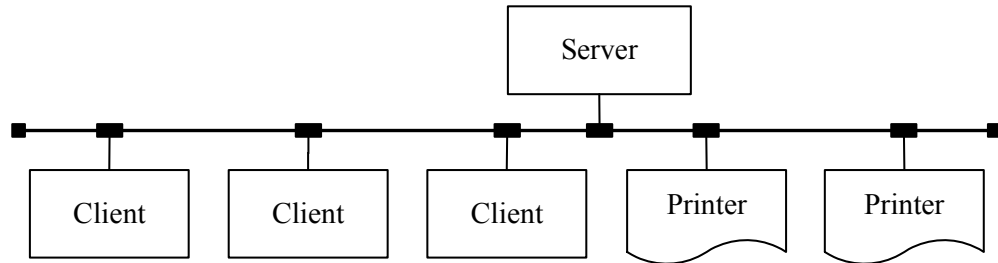
- a) By connecting multiple computers via a network, a high-performance system can be configured.
- b) It can be used by users wherever they are without being aware of the existence of a computer.
- c) Multiple computers are interconnected as a single system. When a failure occurs in some computers in the system, the other computers take over the processing of the failed computers.
- d) Required calculation resources including processing capability and storage capacity in a computer can be purchased only when required.

Q20. As shown in the figure, this configuration consists of two systems. One performs on-line processing as an active system, and the other prepares for failure of the active system as a standby system. The standby system usually performs batch processing. What is this system configuration called?



- a) Dual system
- b) Duplex system
- c) Parallel processor system
- d) Simplex system

Q21. As shown in the figure, one server, three clients, and two printers are connected to the LAN. This system transfers the data on the server to a printer based on instructions from a client. When the availability of each device is as shown in the table, which of the following is the formula indicating the availability of this system? Here, the operation is considered normal if at least one of the three clients and one of the two printers are operating.



Device	Availability
Server	a
Client	b
Printer	c
LAN	1

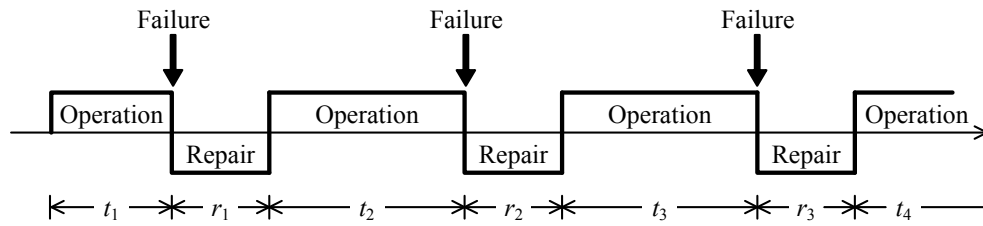
a) ab^3c^2

b) $a(1-b^3)(1-c^2)$

c) $a(1-b)^3(1-c)^2$

d) $a(1-(1-b)^3)(1-(1-c)^2)$

Q22. The system operations model is shown in the figure. Which of the following is the appropriate combination of the expressions indicating MTBF and MTTR in this system? Here, “ t_i ” represents the system operation time, and “ r_i ” represents the system repair time ($i = 1, 2, \dots, n$).



	MTBF	MTTR
a)	$\frac{1}{n} \sum_{i=1}^n r_i$	$\frac{1}{n} \sum_{i=1}^n t_i$
b)	$\frac{1}{n} \sum_{i=1}^n t_i$	$\frac{1}{n} \sum_{i=1}^n r_i$
c)	$\frac{1}{n} \sum_{i=1}^n t_i$	$\frac{1}{n} \sum_{i=1}^n (t_i + r_i)$
d)	$\frac{1}{n} \sum_{i=1}^n (t_i + r_i)$	$\frac{1}{n} \sum_{i=1}^n r_i$

Q32. Which of the following is an appropriate usage of a radio button that is a GUI component?

- a) For each of several options, it is used to specify whether or not to select the option.
- b) It is used to select one option from among a list of options which are displayed when a specific item is selected.
- c) It is used to select one option from among a set of mutually exclusive options.
- d) When one option is selected from several options, it is used to enter an option not found into a text box.

Q33. Which of the following is a human interface design that is intended to improve the consistency of operations?

- a) Designing operation buttons so that they have a common display location and shape on all screens
- b) Displaying the progress status of a user's operation
- c) Providing an "undo" (or cancel) function to restore the operating condition to the previous state
- d) Providing shortcut keys for operations

Q24. Which of the following is an appropriate description concerning RAID?

- a) RAID 0 increases performance by using disk striping. However, the reliability is rather low because damages on even one disk cause whole data to be lost.
- b) RAID 1 enhances both performance and reliability by using disk mirroring. Data can be restored immediately by using redundant disks at the occurrence of a failure.
- c) RAID 3 improves both performance and reliability by generating parity information which is distributed and recorded together with striped data across all disks.
- d) RAID 5 uses bit-level or byte-level striping with a dedicated parity disk, which contributes to improvement of performance and reliability.

Q32. There is a fault-tolerant computer system with high reliability and availability in which two CPUs perform the same processing and compare the processing results to each other. If one CPU fails, the system cuts off the failed CPU and continues processing on the other CPU. What is this system configuration called?

- a) Dual system
- b) Duplex system
- c) Load sharing system
- d) Multiprocessing system

Q33. Which of the following is an appropriate explanation of fault-tolerant systems?

- a) Even in the event of a partial system failure, the system as a whole can provide necessary operational capabilities.
- b) In preparation for local disasters, there is a backup system available in a remote site.
- c) Individual transactions are processed in parallel by multiple processors and the results are compared.
- d) Resources are shared among multiple processors connected via a network.

Q24. From a point of view of better performance, improved fault tolerance, and enhanced data integrity, which of the following RAID configurations is commonly suitable for enterprise systems?

- a) RAID 0 b) RAID 1 c) RAID 3 d) RAID 5

Q33. Which of the following is the system configuration with the highest availability?
Here, multiple systems connected in parallel are considered operating if at least one system is operating.

- a) Four identical systems with each availability of 70% in parallel connection
- b) One system with an availability of 99%
- c) Three identical systems with each availability of 80% in parallel connection
- d) Two identical systems with each availability of 90% in parallel connection

Q34. When machine tools are controlled by microcomputers, which of the following focuses on fail safe?

- a) A hotline for emergency assistance is installed to communicate with the maintenance department of the manufacturer.
- b) Components for individual functions are easy to replace, so repair time can be reduced as much as possible.
- c) Even if a part of the components fails, the process continues without stopping, whenever possible.
- d) The system automatically stops when an abnormal operation signal is detected.

Q35. Which of the following is an appropriate explanation of availability concerning RASIS?

- a) A computer system is maintained in such a state that it can be used whenever necessary.
- b) An average time required for repair and maintenance is measured during a certain period of time within the life of an individual functional unit.
- c) Measures are taken to prevent a computer system from being destroyed or data from being stolen by unauthorized access.
- d) Problem determination, diagnosis, and repair actions are performed effectively in a computer system.

Q32. Which of the following is the appropriate explanation of RPC in a client/server system?

- a) It is a method of communication between programs, where parts of the process are assigned to another computer.
- b) It is a method of remotely using a hard disk of a computer at another location as a shared resource.
- c) It is a method to check whether a user remotely accessing the computer is registered or not.
- d) It is a method where a series of procedures for a database is handled together and processed at the server with the arguments provided by the client.

Q34. Which of the following helps improve availability?

- a) Doubling both MTBF and MTTR
- b) Doubling MTBF and reducing MTTR to half
- c) Reducing both MTBF and MTTR to half
- d) Reducing MTBF to half and doubling MTTR

Q35. Which of the following refers to the concept of fail-safe design?

- a) If a failure occurs in a leased line, the system immediately switches to a public line and continues processing even if the processing capacity of the system goes down.
- b) If a system failure occurs with a data transfer process in a data collection system, only the data input process is performed, and the data is transferred all at once after recovery of its failure.
- c) If something other than a number is entered into a number input field, the system displays a warning message, requesting correct entry.
- d) If the system determines that the sensor which detects someone entering the work area has failed, the robot arm is stopped by force.

Q37. When large-scale websites are built, application servers are often used in addition to Web servers. Which of the following is an appropriate reason for this?

- a) System modification or expansion is made easier in comparison with Web servers alone.
- b) Web servers alone cannot create content dynamically.
- c) Web servers alone cannot execute the business processing.
- d) Web servers do not have authentication functions.

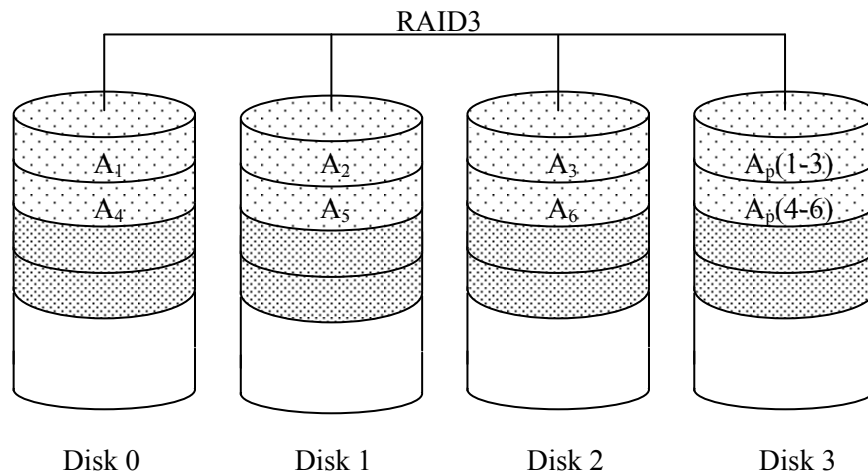
Q50. Which of the following is the most appropriate description concerning a “watch list” of system failures?

- a) “Monitoring software” monitors messages displayed on system consoles.
- b) All of the items that cannot be monitored by “monitoring software” need to be observed by persons in charge.
- c) System operators also monitor processing delays, because such delays can cause system failures.
- d) System operators continuously monitor all items which have the possibility of causing failures.

Q23. In the RAID3 system shown below, three disks (Disks 0 through 2) for byte-striped data and one dedicated parity disk (Disk 3) are used as one volume. Parity byte A_p is generated by calculating the exclusive OR (XOR) of three bytes in Disks 0 through 2. For example, $A_p(1-3)$ is calculated as follows:

$$A_p(1-3) = A_1 \text{ XOR } A_2 \text{ XOR } A_3$$

In the case of drive failure, data recovery can be accomplished by using the information recorded on the remaining three error-free drives. Which of the following operations should be executed for this data recovery?

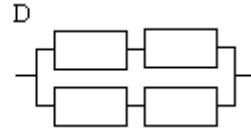
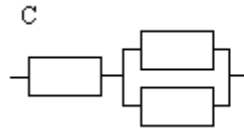
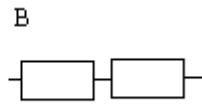
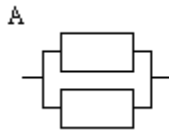


- a) AND OR
- c) XNOR (Exclusive NOR) d) XOR (Exclusive OR)

Q31. Which of the following is an appropriate description concerning throughput?

- a) Spooling in which the output to the printer is temporarily stored on a hard disk drive is helpful for increasing the throughput.
- b) Throughput is an index of the CPU performance, and it is not affected by input/output speed, overhead time, and so on.
- c) Throughput is not affected even if an operator intervention between jobs causes idle time in the system.
- d) While multiple programming contributes to reduction in turn-around time, it does not help increase the throughput.

Q33. Which of the following is the system configuration with the highest availability?
Here, each unit shown by a box has the same availability (less than 1), and multiple units connected in parallel are considered operating if at least one unit is operating.



a) A

b) B

c) C

d) D

Q48. Which of the following most appropriately describes the handling of control information in system operation management?

- a) The system should be managed by a single manager. Control information should be disclosed to the general user after its security level and other factors are considered.
- b) The system should be managed by a small group of managers. The management account should be exclusive to the group and should be shared. Control information should be disclosed to the general user after its security level and other factors are considered.
- c) The system should be managed by a small group of managers. The management account should be exclusive to the group and should be shared. Control information should be disclosed to the general user so that each user can check the information.
- d) The system should be managed by a small group of managers. Each manager should be given an exclusive and separate account. Control information should be disclosed to the general user after its security level and other factors are considered.

Q49. Which of the following is an appropriate description concerning countermeasures to online system failures?

- a) Backup files for journal files and master files should be stored at the same location as the original files so that they can be used quickly for system recovery.
- b) If a transaction could not be completed properly, roll-forward should be performed to return to the state immediately before the transaction began.
- c) Most up-to-date data immediately before the system failure occurred should be recovered using the master file as well as the transaction files prepared on a regular basis to update the master file.
- d) The master file should be backed up not only at the completion of online service but at times corresponding to the characteristics of the system.

Q50. Which of the following can make MTBF longer in system maintenance?

- a) To disperse a single-location maintenance center to various locations
- b) To do preventive maintenance
- c) To do provisional maintenance where a failure has occurred
- d) To do remote maintenance

Q30. Which of the following technologies is used to divide each data file into blocks at constant length and to store them across multiple hard disks that can be accessed in parallel, thereby speeding up file access?

- a) Disk at once
- b) Disk cache
- c) Disk mirroring
- d) Disk striping

Q36. Which of the following is the appropriate statement concerning client/server architecture?

- a) It divides a series of processes into two groups by means of an inter-process communication mechanism; one group includes processes that request services, and the other consists of processes that execute the requested services.
- b) It is mainly aimed at achieving horizontal load sharing by connecting terminals to multiple workstations replacing the host computer.
- c) It is mainly aimed at achieving load sharing by distributing, among the terminals, part of functions and data files to be processed by the host computer.
- d) It is the generic term for a system configuration in which a PC is connected to a workstation via LAN. The PC and workstation are called a client and a server, respectively.

Q37. Which of the following is the primary purpose to use RAID?

- a) To achieve a lower hardware cost
- b) To ensure higher reliability and/or performance
- c) To improve data security
- d) To simplify the hardware configuration for a quick and easy installation

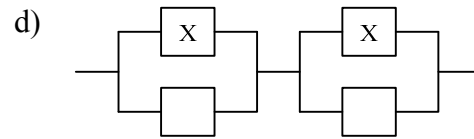
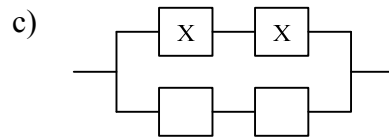
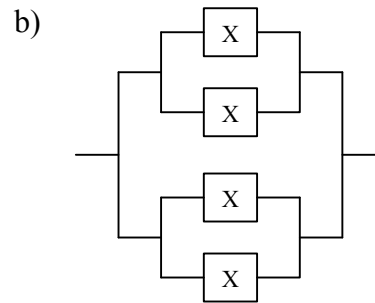
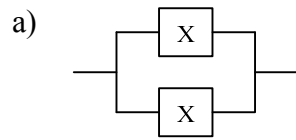
Q40. Which of the following is the appropriate description concerning the performance evaluation of a computer system?

- a) At a stage where the system is not in actual operation, it is possible to predict the performance of the computer system by running experimental simulations using a hardware monitor.
- b) In case that it is planned to enhance computer system resources, the performance, as it will be when the whole system is operating, can be confirmed by means of a prototype model based on load forecasting.
- c) In the case of a system in operation, a software monitor can be used to collect and analyze statistical data, thereby permitting performance-related problems to be grasped.
- d) Since a benchmark program for measuring CPU performance covers a wide range of applications, it can be used for performance prediction at stages ranging from the computer installation to the system enhancement planning.

Q41. Which of the following appropriately describes a dual system?

- a) Processor, memory, channel, power supply system, and so on are duplicated. If a fault occurs in any one of the pairs of equipment, the other is used to continue the processing.
- b) The active system performs online processing, and a standby system stands by performing batch processing, etc. If a fault occurs in the active system, the standby system takes over and continues the online processing.
- c) The online processing program of the active system is loaded in the standby system. If a fault occurs in the active system, the standby system immediately takes over and continues the processing.
- d) Two systems perform the same processing, and the processed results are collated to confirm the correctness of the processing. If a fault occurs in either system, processing continues in degraded operation.

Q43. Which of the following shows the system configuration that can operate with an overall system availability of $(1-(1-A)^2)^2$? Here, the element X is a processor with an availability of A . Also, the segment connected in parallel is considered operating if either of the two processors is operating. However, the segment connected in series is considered operating only when both processors are operating.



Q30. Computer font is an element in the user interface. Which of the following is the most appropriate explanation concerning the font?

- a) A set of characters to be displayed on a computer
- b) A set of glyphs and associated information such as code points
- c) A set of letters used by a computer as an interface to users
- d) A visual representation of generic elements generated from a script

Q39. Which of the following is a system where one computer is in standby mode when the other computer is functioning normally?

- a) Dual system
- b) Duplex system
- c) Load sharing system
- d) Multiprocessing system

Q41. Which of the following is an appropriate statement with regard to system performance evaluation, when selecting a new computer system?

- a) Evaluation can be performed in an environment close to actual use by creating a relatively simple and easy-to-understand program for test purposes, repeatedly running this program as necessary, and measuring the performance.
- b) Evaluation can be performed with high accuracy by using a test program that is relatively unaffected by differences in memory capacity and I/O device configuration.
- c) Performance should be measured in as simple environment as possible. The data required for evaluation can be obtained by running many programs with multiplicity 1.
- d) The data required for evaluation can be acquired by running programs which are frequently used or time critical.

Q11. Which of the following is the average cycles per instruction (CPI) of a computer that can execute 1 billion instructions per second at a clock rate of 2.4 GHz?

a) 0.04

b) 0.12

c) 2.4

d) 25

Q14. A 12-point character is to be displayed on a 96-dpi display in bitmap. How many dots is the height of a square font? Here, 1 point is $1/72$ inch.

a) 8

b) 9

c) 12

d) 16

Q16. In the time-chart of a system shown below, the shaded parts represent the normal working hours of the system, and the white parts represent the time when the system is not available due to failure. The numbers inside each part indicate the start and end hours of each state. Which of the following is the availability of the system?

0~60	60	70~145	14	150~240	2	255~300
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- a) 0.10 b) 0.82 c) 0.90 d) 0.98

Q19. A processor takes 15 seconds to run an application compiled with an old compiler. A new compiler was released. The same application compiled with the new compiler executes fewer instructions by 40%, but the average clock cycles per instruction (CPI) is increased by 10%. How many seconds does it take for the same processor to run the same application compiled with the new compiler?

- a) 4.125 b) 6.6 c) 9.09 d) 9.9

Q16. Which of the following is the approximate availability of a system in percentage when the MTBF is 30 days and the MTTR is 6 hours?

- a) 0.83 b) 83.33 c) 98.36 d) 99.17

Q25. Audio signals are recorded using 8-bit samples at a sampling rate of 11,000 times per second.

When a flash memory of 512×10^6 bytes is used, what is the maximum recording time of such data in minutes?

- a) 77 b) 96 c) 775 d) 969

Q10. A CPU has a clock frequency of 2.0 GHz. When the instructions consist of three types, as shown in the table below, what is the approximate CPU performance in MIPS?

Type	Execution time (clocks)	Frequency of appearance (%)
Instruction 1	15	40
Instruction 2	10	20
Instruction 3	10	40

- a) 16.7 b) 120 c) 167 d) 200

Q16. There exists a device with an MTBF of forty-five (45) hours and an MTTR of five (5) hours. What is the availability of a system that connects two (2) such devices in series?

- a) 0.81 b) 0.90 c) 0.95 d) 0.99

Q9. For a processor running at 50 MIPS, what is the average execution time per instruction?

a) 20 ns

b) 50 ns

c) 2 μ s

d) 5 μ s

Q24. For a given data, the check digit is calculated with the method below and is appended to the original data. When the given data are 7394, what is the result? Here, the weight is 1234 and base number is 11.

- (1) For each digit of the data, calculate the product with the digit at the same radix of the weight; then calculate the sum of the products.
- (2) Calculate the remainder of dividing the sum by the base number.
- (3) Subtract the remainder from the base number; then take the one's place of the result as the check digit.

- a) 73940 b) 73941 c) 73944 d) 73947

Q26. An audio signal is sampled 11,000 times per second while each sample is recorded as an 8-bit data. When a 512×10^6 -byte capacity flash memory is used, what is the maximum number of minutes to record such data?

a) 77

b) 96

c) 775

d) 969

Q21. A D/A converter with a resolution of 8 bits generates an output voltage of 0 volts for a digital input value of 0, and an output voltage of 2.5 volts for a digital input value of 128. When the lowest 1 bit of the digital input value is changed, which of the following is the change (in volts) of the output voltage that is generated by the D/A converter?

- a) $2.5/128$
- b) $2.5/255$
- c) $2.5/256$
- d) $2.5/512$

Q4. Analog audio data is being sampled and converted to 8-bit digital audio data using the PCM method, then transmitted in 64,000 bits per second. What is the sampling interval in microseconds?

a) 15.6

b) 46.8

c) 125

d) 128

Q14. There exists a system composed of two processing devices. What is the difference in availability between the system that works when either of the devices functions normally and the one when both devices function normally? Here, the availability for both devices is 0.9, and factors other than the processing devices can be ignored.

a) 0.09

b) 0.10

c) 0.18

d) 0.19

Q16. Consider a RAID 0 (i.e., block-level striping without parity or mirroring) system with two disks; when data is distributed evenly across the two disks and both disks have a failure rate of 0.1%, what is the overall failure rate (as a percentage) of this RAID system? Here, the overall failure rate refers to the probability that the system fails to obtain data from either of the disks.

- a) 0.0001 b) 0.0100 c) 0.1999 d) 1.9990

Q14. A system is operated as a virtual machine environment with 20 physical machines. When the operating conditions are shown below, what is the minimum number of physical machine failures that causes the system to enter fall back operation?

[Operating conditions]

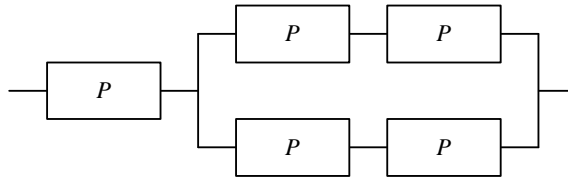
- (1) If a physical machine fails, the virtual machines that were running on it are made to run evenly on all the other physical machines, and the resources that were used are distributed in the same way.
- (2) When there are 20 physical machines, 70% of the resources of all physical machines are used.
- (3) If the resources used on a single physical machine exceed 90%, the whole system enters fall back operation.
- (4) Conditions other than (1) through (3) above do not need to be considered.

- a) 2 b) 3 c) 4 d) 5

Q18. Which of the following is the mean time between failures (MTBF) value of the entire system where unit *A* and unit *B* are connected in series and both units operate as one system? The MTBF value of unit *A* and unit *B* is 200 and 300 hours, respectively.

- a) 200 b) 250 c) 300 d) 500

Q16.



- a) $1 - (1 - P)(1 - P^2)^2$ b) $P\{1 - (1 - P)^4\}$
c) $P\{1 - (1 - P)^2\}^2$ d) $P\{1 - (1 - P^2)^2\}$

Q12. There exists a system that requires the execution of 800,000 instructions per transaction. When the processor performance is 200 MIPS and the utilization rate of the processor is 80%, what is the processing power in transactions per second?

- a) 20 b) 200 c) 250 d) 313

Q17. There exist the same two devices, each with an MTBF of 45 hours and an MTTR of 5 hours. What is the availability of a system that connects these two devices in series?

- a) 0.81 b) 0.90 c) 0.95 d) 0.99

Q24. A D/A (digital-to-analog) converter with a resolution of 8 bits generates the output voltage 0 volts for the digital input value 0, and the output voltage 2.5 volts for the digital input value 128. When the lowest one bit of the digital input value is changed, which of the following is the change (in volts) of the output voltage that is generated by the D/A converter?

a) $\frac{2.5}{128}$

b) $\frac{2.5}{255}$

c) $\frac{2.5}{256}$

d) $\frac{2.5}{512}$

Q12. As shown in the table below, when a computer executes three types of instructions A, B, and C, what is the performance in MIPS of the computer?

Instruction type	Execution time (nanoseconds)	Frequency of appearance (%)
A	10	40
B	20	30
C	50	30

- a) 2.5 b) 8 c) 10 d) 40

Q19. The table below shows the number of failures per day and the average repair time (in minutes) per failure that are observed during the first 2 days in a newly installed system. What is the approximate availability of the system during that period? Here, the system is expected to operate for 24 hours every day.

Day	Number of failures per day	Average repair time per failure
1	12	30
2	6	20

- a) 0.17 b) 0.20 c) 0.80 d) 0.83

Q20. In the RAID0 and RAID1 systems using two disks, when one disk has a reliability rate of 99% and the other has a reliability rate of 97%, which of the following is the appropriate combination of each failure rate (in percentage) of RAID0 and RAID1? Here, the failure rate is calculated by using the formula below.

$$\text{failure rate (\%)} = 100\% - \text{reliability rate (\%)}$$

	RAID0	RAID1
a)	0.02	3.00
b)	0.03	3.97
c)	3.97	0.02
d)	3.97	0.03

Q30. Audio is sampled and recorded at a frequency of 11,000 times per second with a resolution of 8 bits per sample. How many minutes of audio at maximum can be recorded in flash memory with a capacity of 512×10^6 bytes?

a) 77

b) 96

c) 775

d) 969

Q12. When the average instruction execution time of a computer is 20 nanoseconds, what is the performance of this computer in MIPS?

- a) 5 b) 10 c) 20 d) 50

Q23. When the MTBF and MTTR values for devices *A* and *B* are as shown in the table below, what is the availability of a system where *A* and *B* are connected in series?

Unit: hour

Device	MTBF	MTTR
<i>A</i>	80	20
<i>B</i>	180	20

a) 0.72

b) 0.80

c) 0.85

d) 0.90

Q12. When a processor performs multimedia or graphic-related application programs with the mixture of vector instructions and scalar instructions, 10% of the computation time is used for vector instructions. When a newly developed processor can execute vector instructions twice faster than the original processor, approximately how many times faster is the speed of the new processor than that of the original one in the same application environment?

- a) 1.0275 b) 1.0465 c) 1.0500 d) 1.0526

Q22. In a certain processor, a timer interrupt is generated at a clock frequency of 60 Hz on a “per clock tick” basis. It takes 2 milliseconds (including process switching overhead) to handle the interrupt. What is the percentage of the interrupt handling time in the processor?

- a) 6 b) 12 c) 24 d) 60

Q18. In an on-line real-time system, there occur transactions at a frequency of 20 times per second. Each of the transactions is completed after it performs the CPU processing once and the hard disk I/O processing four times. The I/O processing time of a hard disk drive is 40 milliseconds per each I/O, and the CPU processing time is negligibly small. When each hard disk drive is accessed evenly, at least how many hard disk drives are required for this transaction processing?

- a) 3 b) 4 c) 5 d) 6

Q11. In a certain CPU, a floating point adder unit uses a total of 40 percent of the execution time. If the floating point adder unit is replaced with a new unit whose speed is ten times faster than the original unit, approximately how many times faster is the new CPU than the original one? Here, there is no modification in the instruction set of the new CPU.

- a) 1.25 b) 1.40 c) 1.56 d) 2.17

Q12. There is a CPU with a clock frequency of 1 GHz. When the instructions consist of two types as shown in the table below, what is the performance in MIPS of the CPU?

Type	Execution time (clocks)	Frequency of appearance (%)
Instruction 1	10	60
Instruction 2	5	40

- a) 34 b) 100 c) 125 d) 133

Q24. In a certain file server system, it takes 15 ms to process one transaction if the target data is available in the disk cache. If the target data is stored in the hard disk in lieu of the disk cache, additional 75 ms for disk access is required to process it. When two-thirds of the number of transactions can be processed by using the disk cache data only, how many transactions per second on average can be consecutively handled in this system? Here, no parallel operation of disk access and data processing is performed. Overhead, such as communication and OS, can be ignored.

- a) 15 b) 18 c) 25 d) 28

Q22. When a microprocessor works at a clock speed of 200 MHz and the average CPI (“cycles per instruction” or “clocks per instruction”) is 4, how long does it take to execute one instruction on average?

- | | |
|-------------------|--------------------|
| a) 5 nanoseconds | b) 20 nanoseconds |
| c) 5 milliseconds | d) 20 milliseconds |

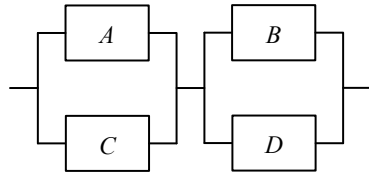
Q34. There are four hard disk subsystems A , B , C , and D including two or three disks with designated MTBF values as shown in the table below. Which of the following hard disk subsystems can provide the highest reliability? Here, if one of the disks fails in each subsystem, it is regarded as a failure of the entire hard disk subsystem.

Unit: hour

Hard disk subsystem	MTBF		
	Disk 1	Disk 2	Disk 3
A	400,000	600,000	–
B	400,000	500,000	600,000
C	500,000	500,000	–
D	500,000	500,000	500,000

- a) A b) B c) C d) D

Q35. Which of the following is the closest value as overall availability of the system composed of the four devices A to D ? Here, availability of individual device is 0.9 for A and C , and 0.8 for B and D . In addition, when either of the parallel connections is operating, the corresponding parallel portion can be regarded as operating.



a) 0.72

b) 0.92

c) 0.93

d) 0.95

Q20. In a certain intrusion detection system, a detector is driven by a 4 KHz crystal clock oscillator and checks intrusion every 1,000 clock pulses. How many times per minute does the detector check intrusion in this system?

- a) 24 b) 120 c) 240 d) 250

Q22. A CPU that operates at 1 GHz is known to execute one machine-language instruction in an average time of 0.8 clocks. Approximately how many million instructions can be executed by this CPU in one second?

- a) 1.25 b) 2.5 c) 800 d) 1250

Q32. When a certain job is executed in a computer system, 35 percent of the total processing time of the job is used for CPU and the rest is spent waiting for I/O to complete. If a newer CPU whose speed is three times faster than the current one is installed, approximately how many times faster is the new system than the current system? Here, the system environment except for the CPU remains unchanged.

- a) 1.1 b) 1.3 c) 1.8 d) 3.0

Q50. A value is calculated from a given data according to specific rules, and then a check character is determined from this value and appended to the given data. This is used to check the input data.

When the rules listed below are used, which of the following is the correct check character to be appended to the four-digit numeric data “2131”?

[Rules]

- (1) Assign the coefficients 4, 3, 2, and 1 to each digit of the given data, in order from the first (leftmost).
- (2) Multiply each digit by its assigned coefficient, and calculate the sum of each product.
- (3) Divide the sum obtained in Step (2) by 11, and obtain the remainder.
- (4) The value of the remainder obtained in Step (3) is the check character. Here, when the remainder is 10, “X” is assigned to the check character.

- a) 1 b) 3 c) 5 d) 7

Q22. There is a CPU with an internal clock frequency of 700 MHz. The number of clock cycles for executing instructions and their appearance rates are shown in the table below. What is the approximate performance (measured in MIPS) of this CPU?

Type of instructions	Number of clock cycles for executing instructions	Appearance rate (%)
Operation between registers	4	30
Operation between memory and registers	8	60
Unconditional branch	10	10

a) 10

b) 50

c) 70

d) 100

Q33. In order to make a multiplexing system with an availability of at least 0.999 by using devices with an availability of 0.9, how many of these devices need linking together in parallel?

- a) 2 b) 3 c) 4 d) 5

Q24. A system manages files by allocating file storage on a block-by-block basis, where each block consists of eight 500-byte sectors. How many sectors in total are required to store two files: one with 2,000 bytes and the other with 9,000 bytes? Here, sectors for management information such as directories can be ignored.

a) 22

b) 26

c) 28

d) 32

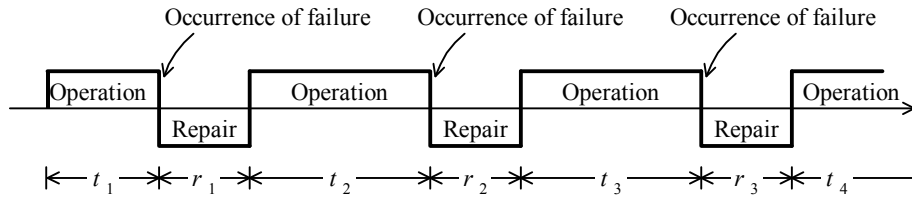
Q32. Last year, a company providing web application services needed an Internet line to service clients' demand at that time. However, in order to increase availability, the company actually made use of two Internet lines from different vendors. This year, the demand is doubled and both lines are fully busy, so the company will install one more Internet line. Each of the Internet lines has availability of 80%. What percentage of availability will be cut down after the installation?

- a) 0.8 b) 4.8 c) 7.8 d) 12.8

Q38. There is an RAID5 disk array system that is composed of 10 hard disk drives, and each disk capacity is 100Gbytes. What is the approximate maximum capacity (in Gbytes) that can be used to store user data and/or programs on this system?

- a) 450 b) 500 c) 900 d) 1,000

Q42. When the operational model of a system is shown in the figure below, which of the following represents the correct combination of MTBF and MTTR of the system? Here, t_i ($i = 1, 2, \dots, n$) denotes the operating time of the system, and r_i ($i = 1, 2, \dots, n$) denotes the repair time of the system.



	MTBF	MTTR
a)	$\frac{1}{n} \sum_{i=1}^n r_i$	$\frac{1}{n} \sum_{i=1}^n t_i$
b)	$\frac{1}{n} \sum_{i=1}^n t_i$	$\frac{1}{n} \sum_{i=1}^n r_i$
c)	$\frac{1}{n} \sum_{i=1}^n t_i$	$\frac{1}{n} \sum_{i=1}^n (t_i + r_i)$
d)	$\frac{1}{n} \sum_{i=1}^n (t_i + r_i)$	$\frac{1}{n} \sum_{i=1}^n r_i$

Q40. There is a CPU whose clock cycle time is 0.01 microsecond. The table below shows a program's instruction mix executed on the CPU. What is the approximate MIPS value for the processor?

Type of instruction	Number of clock cycles required for instruction execution	Frequency of occurrence
Data transfer instructions	5	70%
Calculation instructions	10	15%
Decision instructions	5	10%
Jump instruction	1	5%
Total		100%

- a) 4.76 b) 10.30 c) 18.02 d) 20.70

Q42. A company uses 1,000 PCs. The mean failure in 20 days is to be restricted to 2 PCs. How many hours of MTBF are at least required for these PCs? Here, the mean usage time of the PCs is assumed to be 8 hours per day.

- a) 8,000 b) 20,000 c) 80,000 d) 160,000

Q55. A check digit for a 4-digit number $X_1X_2X_3X_4$ can be calculated as follows:

$$\text{mod}((X_1 \times 4 + X_2 \times 3 + X_3 \times 2 + X_4 \times 1), 10)$$

When the check digit for the 4-digit number “7X₂42” is equal to 6, which of the following is the correct number to be put in X₂? Here, $\text{mod}(a,b)$ returns the remainder after “ a ” is divided by “ b .”

a) 5

b) 6

c) 7

d) 8