=== TOPIC: Operating System, LEVEL: easy ===

1. What is an operating system?

A) A type of computer virus

B) Software that manages computer hardware and software resources

C) A programming language

D) A web browser

Answer: B

2. Which of the following is the main function of an operating system?

A) Playing games

B) Managing hardware resources

C) Creating documents

D) Browsing the internet

Answer: B

3. The operating system acts as an interface between:

A) Hardware and user

B) User and application programs

C) Hardware and application programs

D) Internet and computer

Answer: C

4. Which of these is an example of an operating system?

A) Microsoft Word

B) Windows 10

C) Google Chrome

D) Adobe Photoshop

Answer: B

5. Which of the following is NOT an operating system?

A) Linux

B) macOS

C) MS Excel

D) Android

Answer: C

6. What does GUI stand for in the context of operating systems?

A) General User Interface

B) Graphical User Interface

C) Global User Interaction

D) Graphic Utility Input

Answer: B

7. Which operating system is most commonly used on personal computers worldwide?

A) Linux

B) macOS

C) Microsoft Windows

D) UNIX

Answer: C

8. The kernel is the:

A) Highest part of the OS

B) Core or central part of the operating system

C) User application

D) Hardware component

Answer: B

9. Which of these is a popular mobile operating system?

A) Windows

B) Android

C) MS-DOS

D) Ubuntu Server

Answer: B

10. What is the full form of BIOS?

A) Basic Input Output System

B) Binary Input Output Service

C) Built-in Input Output Software

D) Basic Integrated Operating System

Answer: A

11. Which type of operating system allows only one user at a time?

A) Multi-user

B) Single-user

C) Real-time

D) Distributed

Answer: B

12. Which of the following is an example of a multi-user operating system?

A) MS-DOS

B) Windows 11 Home

C) UNIX

D) Windows XP Home

Answer: C

13. A real-time operating system is mainly used in:

A) Gaming computers

B) Systems where timing is critical (e.g., robots, air traffic control)

C) Web browsing

D) Word processing

Answer: B

14. Which operating system is known as open-source?

A) Windows

B) macOS

C) Linux

D) iOS

Answer: C

15. Batch operating systems are used for:

A) Interactive jobs

B) Jobs that are grouped and processed without user interaction

C) Real-time processing

D) Multi-user chatting

Answer: B

16. What is a process in an operating system?

A) A running program

B) A hardware device

C) A file on disk

D) A web page

Answer: A

17. Which is the smallest unit that can be scheduled by the CPU?

A) Process

B) Thread

C) Program

D) File

Answer: B

18. What happens during context switching?

A) The CPU switches from one process to another

B) Files are deleted

C) RAM is cleared

D) The computer restarts

Answer: A

19. The "ready" state of a process means it is waiting for:

A) I/O operation

B) CPU time

C) Termination

D) Memory full

Answer: B

20. Multitasking means:

A) Running multiple programs at the same time

B) Using only one program

C) Deleting files

D) Printing documents

Answer: A

21. Virtual memory is a technique that allows:

A) Using disk space as extra RAM

B) Deleting memory

C) Increasing CPU speed

D) Changing file names

Answer: A

22. What is the purpose of a file system in an OS?

A) To manage files and folders

B) To run games

C) To connect to the internet

D) To compile code

Answer: A

23. Which of these is a common file system used in Windows?

A) NTFS

B) ext4

C) HFS+

D) APFS

Answer: A

24. RAM stands for:

A) Read Access Memory

B) Random Access Memory

C) Run Access Memory

D) Real Active Memory

Answer: B

25. Which memory is volatile (loses data when power is off)?

A) Hard disk

B) ROM

C) RAM

D) Pen drive

Answer: C

26. Which scheduling algorithm gives equal time to each process?

A) First Come First Serve

B) Round Robin

C) Shortest Job First

D) Priority

Answer: B

27. What is a system call?

A) A request from a program to the OS kernel

B) A phone call

C) A computer shutdown

D) A file copy

Answer: A

28. User mode and kernel mode are used to provide:

A) Security and protection

B) Faster internet

C) Better graphics

D) More storage

Answer: A

29. Which of these is a command-line operating system?

A) Windows 11

B) macOS

C) MS-DOS

D) Ubuntu with GUI

Answer: C

30. Booting means:

A) Starting the computer and loading the OS

B) Deleting files

C) Connecting to Wi-Fi

D) Printing a document

Answer: A

31. Which key is commonly pressed to enter BIOS setup?

A) F1

B) Del or F2 (varies by system)

C) Enter

D) Spacebar

Answer: B

32. What does "plug and play" refer to in OS?

A) Automatically detecting and configuring hardware

B) Playing music

C) Plugging in cables only

D) Manual driver installation

Answer: A

33. Which OS is developed by Apple?

A) Windows

B) Linux

C) macOS

D) Android

Answer: C

34. Android is primarily used on:

A) Desktop computers

B) Smartphones and tablets

C) Supercomputers

D) Routers

Answer: B

35. Which of these helps protect the system from unauthorized access?

A) Login password

B) High resolution screen

C) More RAM

D) Faster CPU

Answer: A

36. The Recycle Bin in Windows is used to:

A) Store deleted files temporarily

B) Store important files

C) Run programs

D) Connect to internet

Answer: A

37. What is the term for when the OS runs multiple applications?

A) Multiprogramming

B) Single tasking

C) Hardware control

D) File deletion

Answer: A

38. Which is a function of the OS file manager?

A) Create, delete, and organize files

B) Play videos only

C) Compile code

D) Manage network only

Answer: A

39. Spooling is used for:

A) Managing print jobs in buffer

B) Speeding up CPU

C) Deleting files

D) Increasing RAM

Answer: A

40. Which OS was the first widely used GUI-based system by Microsoft?

A) MS-DOS

B) Windows 1.0

C) Windows 95

D) Windows XP

Answer: B

41. What is the purpose of device drivers in OS?

A) To allow communication between OS and hardware

B) To store files

C) To run games

D) To browse internet

Answer: A

42. Multithreading allows:

A) Multiple threads within a single process

B) Deleting threads

C) Only one task

D) Hardware failure

Answer: A

43. Which is a popular Linux distribution?

A) Ubuntu

B) Windows

C) iOS

D) macOS

Answer: A

44. The taskbar is a feature of which OS?

A) Windows

B) Linux only

C) macOS only

D) Android

Answer: A

45. What does "deadlock" mean in OS? (basic awareness)

A) Processes waiting for each other forever

B) Fast execution

C) File saved

D) Computer shutdown

Answer: A

46. Which key combination is used to open Task Manager in Windows?

A) Ctrl + Alt + Delete

B) Ctrl + C

C) Alt + F4

D) Ctrl + S

Answer: A

47. ROM stands for:

A) Read Only Memory

B) Random Only Memory

C) Run Only Memory

D) Read Access Memory

Answer: A

48. Which of these is an example of application software, not OS?

A) Notepad

B) Windows 10

C) Linux Kernel

D) Android OS

Answer: A

49. The OS manages which of these resources?

A) CPU time, memory, I/O devices

B) Only keyboard

C) Only monitor

D) Only mouse

Answer: A

50. What is the first program that runs when a computer starts?

A) Operating System (after BIOS)

B) MS Word

C) Web browser

D) Paint

Answer: A

=== TOPIC: Operating System, LEVEL: medium ===

1. Which scheduling algorithm can cause the convoy effect?

A) Round Robin

B) Shortest Job First

C) First Come First Served

D) Priority Scheduling

Answer: C

2. In Round Robin scheduling, the main performance factor depends on:

A) Number of processes

B) Time quantum size

C) Process arrival time

D) Priority of processes

Answer: B

3. Preemptive scheduling can be used in:

A) FCFS only

B) SJF and Round Robin

C) FCFS and Priority

D) Only non-preemptive algorithms

Answer: B

4. The average waiting time is minimum in which non-preemptive scheduling?

A) FCFS

B) SJF

C) Priority

D) Round Robin

Answer: B

5. Which of the following is true for multilevel queue scheduling?

A) All queues have the same scheduling algorithm

B) Different queues can have different scheduling algorithms

C) It is always preemptive

D) It eliminates starvation completely

Answer: B

6. Aging is a technique used to:

A) Prevent starvation in priority scheduling

B) Reduce context switching overhead

C) Increase CPU utilization

D) Manage memory paging

Answer: A

7. The dispatcher is responsible for:

A) Allocating CPU to a process

B) Creating new processes

C) Terminating processes

D) Handling I/O requests

Answer: A

8. In which process state does the process wait for an event (I/O or signal)?

A) Ready

B) Running

C) Blocked/Waiting

D) New

Answer: C

9. Inter-process communication using shared memory is:

A) Faster than message passing

B) Slower than message passing

C) Always safer than message passing

D) Not possible in modern OS

Answer: A

10. Which of these is NOT a classic IPC mechanism in UNIX?

A) Pipes

B) Message queues

C) Shared memory

D) Virtual memory

Answer: D

11. A thread is also known as:

A) Heavyweight process

B) Lightweight process

C) Independent program

D) Hardware component

Answer: B

12. The main advantage of user-level threads over kernel-level threads is:

A) Better parallelism

B) Faster context switching

C) More security

D) Automatic load balancing

Answer: B

13. Which synchronization primitive can have a value greater than 1?

A) Mutex

B) Binary semaphore

C) Counting semaphore

D) Spinlock

Answer: C

14. Critical section problem must satisfy which property to ensure correctness?

A) Mutual exclusion, progress, bounded waiting

B) Only mutual exclusion

C) Only progress

D) Only bounded waiting

Answer: A

15. Peterson’s solution is used for:

A) Two-process mutual exclusion

B) Multi-process synchronization

C) Deadlock prevention

D) Memory management

Answer: A

16. Which of these is a deadlock prevention technique?

A) Circular wait prevention by resource ordering

B) Banker's algorithm

C) Wait-for graph

D) Resource allocation graph

Answer: A

17. Test-and-Set instruction is used to implement:

A) Semaphores

B) Mutex locks

C) Monitors

D) All of the above

Answer: D

18. Priority inversion can be solved using:

A) Priority inheritance protocol

B) Round Robin scheduling

C) FCFS

D) Increasing time quantum

Answer: A

19. Which synchronization construct supports conditional variables?

A) Semaphore

B) Mutex

C) Monitor

D) Spinlock

Answer: C

20. Race condition occurs when:

A) Multiple processes access shared data concurrently without synchronization

B) Processes wait forever

C) CPU switches too frequently

D) Memory is over-allocated

Answer: A

21. External fragmentation occurs in:

A) Paging

B) Segmentation

C) Swapping

D) Demand paging

Answer: B

22. Which memory allocation scheme suffers from internal fragmentation?

A) Fixed partitioning

B) Paging

C) Segmentation with paging

D) Virtual memory

Answer: A

23. The page size in most modern systems is:

A) 512 bytes

B) 4 KB

C) 64 KB

D) 1 MB

Answer: B

24. Belady's anomaly occurs in which page replacement algorithm?

A) LRU

B) Optimal

C) FIFO

D) Second chance

Answer: C

25. In demand paging, a page fault occurs when:

A) Required page is not in main memory

B) Page is in main memory

C) Process terminates

D) CPU is idle

Answer: A

26. Thrashing happens due to:

A) Too few processes in memory

B) Excessive paging activity

C) Large page size

D) Small time quantum

Answer: B

27. Working set model is used to:

A) Prevent thrashing

B) Allocate memory frames

C) Replace pages

D) Schedule processes

Answer: A

28. The purpose of TLB (Translation Lookaside Buffer) is to:

A) Speed up page table lookup

B) Store process priorities

C) Manage disk scheduling

D) Handle interrupts

Answer: A

29. Inverted page tables are used to:

A) Reduce memory overhead for page tables

B) Increase page faults

C) Support larger page sizes

D) Eliminate external fragmentation

Answer: A

30. Segmentation provides:

A) Memory protection and sharing at logical level

B) Fixed-size partitions

C) No protection

D) Only physical addressing

Answer: A

31. All four conditions for deadlock are:

A) Mutual exclusion, hold & wait, no preemption, circular wait

B) Only mutual exclusion and circular wait

C) Only hold & wait

D) Only no preemption

Answer: A

32. Banker's algorithm is used for:

A) Deadlock avoidance

B) Deadlock detection

C) Deadlock prevention

D) Deadlock recovery

Answer: A

33. Resource allocation graph with a cycle always means:

A) Deadlock if all resources have single instance

B) Deadlock in all cases

C) No deadlock

D) Only starvation

Answer: A

34. Which disk scheduling algorithm has the least average seek time?

A) FCFS

B) SSTF

C) SCAN

D) C-LOOK

Answer: B

35. C-SCAN scheduling is preferred over SCAN because:

A) It provides more uniform wait time

B) It has lower seek time

C) It is simpler

D) It avoids starvation completely

Answer: A

36. In UNIX, the superblock contains:

A) File system metadata

B) File content

C) Process information

D) User details

Answer: A

37. Inode in UNIX/Linux stores:

A) File metadata but not the name

B) File name and content

C) Process ID

D) Directory structure only

Answer: A

38. Which allocation method causes external fragmentation?

A) Contiguous allocation

B) Linked allocation

C) Indexed allocation

D) FAT

Answer: A

39. DMA (Direct Memory Access) is used to:

A) Reduce CPU overhead during I/O

B) Increase CPU utilization

C) Manage memory paging

D) Schedule processes

Answer: A

40. Spooling is mainly used for:

A) Printers and other slow output devices

B) Fast input devices

C) CPU scheduling

D) Memory allocation

Answer: A

41. Access matrix model is used for:

A) Protection and access control

B) Deadlock detection

C) Page replacement

D) CPU scheduling

Answer: A

42. Capability list is an alternative to:

A) Access control list

B) Page table

C) Process control block

D) File allocation table

Answer: A

43. Which bit in page table entry indicates whether the page has been modified?

A) Dirty bit

B) Valid bit

C) Reference bit

D) Protection bit

Answer: A

44. Fork() system call in UNIX creates:

A) Exact copy of parent process

B) Thread

C) New file

D) New user

Answer: A

45. Zombie process is a process that:

A) Has terminated but entry remains in process table

B) Is currently running

C) Is waiting for I/O

D) Has been killed forcefully

Answer: A

46. Orphan process is adopted by:

A) init process (PID 1)

B) Parent process

C) Kernel directly

D) Child process

Answer: A

47. Which is a non-preemptive scheduling algorithm?

A) Round Robin

B) SJF (non-preemptive version)

C) Priority (preemptive)

D) Multilevel feedback queue

Answer: B

48. The main goal of multiprogramming is to:

A) Increase CPU utilization

B) Reduce response time

C) Eliminate fragmentation

D) Prevent deadlock

Answer: A

49. Which layer of OS is closest to hardware?

A) Kernel

B) Shell

C) Application programs

D) User interface

Answer: A

50. Virtual memory is implemented using:

A) Demand paging and/or segmentation

B) Only contiguous allocation

C) Only fixed partitioning

D) ROM only

Answer: A

=== TOPIC: Operating System, LEVEL: hard ===

1. In a multilevel feedback queue with three queues (q1: RR quantum 8 ms, q2: RR quantum 16 ms, q3: FCFS), a long CPU-bound process will eventually behave most like:

A) RR with quantum 8 ms

B) RR with quantum 16 ms

C) FCFS

D) SJF

Answer: C

2. A system uses aging in priority scheduling. If priority increases by 1 every 10 ms of waiting and maximum priority is 31, a process with initial priority 10 that has waited 400 ms will have priority:

A) 31

B) 30

C) 50

D) 10

Answer: A

3. In Completely Fair Scheduler (CFS), vruntime is increased by:

A) Actual runtime × (1024 / nice_to_weight(nice))

B) Actual runtime only

C) Time quantum only

D) Priority value directly

Answer: A

4. Which scheduling algorithm guarantees that no process waits more than (n-1)×q time in the worst case (n = number of processes, q = time quantum)?

A) Round Robin

B) Multilevel Feedback Queue with aging

C) Lottery scheduling

D) Stride scheduling

Answer: A

5. In a real-time system using Rate Monotonic Scheduling (RMS), schedulability is guaranteed if CPU utilization ≤

A) n(2^(1/n) − 1)

B) ln(2) ≈ 0.693

C) 1.0

D) n(2^(1/n) + 1)

Answer: A

6. A 32-bit system uses two-level paging with 4 KB page size and 4-byte PTE. How many bits are used for the outer page table index?

A) 10

B) 12

C) 8

D) 14

Answer: A

7. In a three-level page table system (32-bit VA, 4 KB pages, 4-byte PTE), the number of page directory entries is:

A) 1024

B) 512

C) 256

D) 2048

Answer: A

8. Belady's anomaly is guaranteed NOT to occur in:

A) FIFO

B) LRU

C) Random replacement

D) Second-chance

Answer: B

9. In the working set model, if the working set window Δ is too large, the primary risk is:

A) Thrashing

B) Under-utilization of memory

C) High page fault rate

D) Excessive swapping

Answer: B

10. A system with 5 processes and 3 resource types has an unsafe state according to Banker's algorithm. This implies:

A) Deadlock has already occurred

B) Deadlock is possible in the future

C) System is deadlock-free forever

D) Resources must be immediately released

Answer: B

11. In a system with multiple instances of resources, a cycle in the resource allocation graph:

A) Guarantees deadlock

B) Indicates possible deadlock

C) Guarantees no deadlock

D) Indicates starvation only

Answer: B

12. Which of these does NOT prevent deadlock (using the four necessary conditions)?

A) Allow hold-and-wait

B) Preempt resources when needed

C) Request all resources at start

D) Order resources numerically

Answer: A

13. In priority ceiling protocol, a task's priority is raised to:

A) The highest priority of any task that uses the same resource

B) The priority of the currently blocked higher-priority task

C) System maximum priority

D) Its original priority

Answer: A

14. The sequence number in Lamport's logical clock is incremented:

A) Only when sending a message

B) On every internal event, send, and receive

C) Only on receive

D) Only when receiving a message with higher timestamp

Answer: B

15. In Ricart-Agrawala mutual exclusion algorithm, a process enters CS when:

A) It has received OK from all other processes

B) It is the one with minimum process ID

C) The coordinator grants permission

D) It times out

Answer: A

16. In a UNIX-like file system with 4 KB block size and 32-bit block pointers, single-indirect block can point to how many data blocks?

A) 1024

B) 2048

C) 4096

D) 512

Answer: A

17. Maximum file size in traditional UNIX filesystem (12 direct + 1 single + 1 double + 1 triple indirect, 1 KB block, 4-byte pointer):

A) ≈ 16 GB

B) ≈ 4 GB

C) ≈ 64 MB

D) ≈ 256 MB

Answer: A (approx)

18. C-LOOK disk scheduling is better than LOOK because:

A) It reduces variance in waiting time for requests at both ends

B) It always serves requests in one direction only

C) It has lower total head movement

D) It eliminates starvation

Answer: A

19. In log-structured file systems (LFS), the main advantage is:

A) Very high write performance for sequential writes

B) Faster random reads

C) No fragmentation

D) Smaller metadata

Answer: A

20. Journaling in ext3/ext4 primarily protects against:

A) System crash during metadata update

B) Disk hardware failure

C) File content corruption

D) Incorrect file permissions

Answer: A

21. In Linux, the O(1) scheduler was replaced by CFS mainly because:

A) Better fairness for interactive tasks

B) Lower context switch time

C) Simpler implementation

D) Support for real-time tasks

Answer: A

22. Transparent Huge Pages (THP) in Linux primarily reduce:

A) TLB misses for large contiguous memory regions

B) Page fault rate

C) Internal fragmentation

D) External fragmentation

Answer: A

23. In RCU (Read-Copy-Update), a grace period ends when:

A) All pre-existing RCU read-side critical sections have completed

B) All writers finish

C) All readers acquire the lock

D) The CPU enters idle state

Answer: A

24. Priority inversion using priority inheritance can still lead to:

A) Chained blocking (multiple medium-priority tasks)

B) Deadlock

C) Starvation of low-priority tasks

D) Thrashing

Answer: A

25. In a NUMA system, first-touch memory allocation policy means:

A) Memory is allocated on the node where the first access occurs

B) Memory is allocated on the local node of the allocating thread

C) Memory is striped across all nodes

D) Memory is allocated on the boot node

Answer: A

26. The main drawback of optimistic concurrency control (used in some transactional memory systems) is:

A) High abort rate under high contention

B) Requires global locking

C) Cannot handle read-write conflicts

D) Needs centralized timestamp service

Answer: A

27. In Linux, the futex (fast userspace mutex) system call is used to:

A) Avoid kernel transition when there is no contention

B) Implement spinlocks

C) Replace semaphores completely

D) Handle priority inheritance

Answer: A

28. A system implements per-process LRU page replacement. If process P1 is allocated 5 frames and P2 gets 3 frames, this is an example of:

A) Local page replacement policy

B) Global page replacement policy

C) Fixed frame allocation

D) Variable frame allocation with global LRU

Answer: A

29. In a system using inverted page tables, the main disadvantage compared to forward-mapped page tables is:

A) Linear search time to find PTE (without hashing)

B) Higher memory overhead

C) No support for shared pages

D) Increased TLB misses

Answer: A

30. The main purpose of the vsyscall page in older Linux kernels was:

A) Allow certain system calls to execute without syscall instruction (faster)

B) Store virtual memory layout

C) Handle page faults

D) Implement futex

Answer: A

31. In a system with copy-on-write (COW), when fork() is called:

A) Pages are marked read-only and copied only on write

B) All pages are immediately copied

C) Only stack is copied

D) No memory is shared

Answer: A

32. Linux kernel uses which technique to reduce lock contention on the runqueue?

A) Per-CPU runqueues

B) Global runqueue with RCU

C) Single spinlock for all CPUs

D) Priority queues only

Answer: A

33. The convoy effect is worst in:

A) FCFS scheduling

B) Round Robin with very large quantum

C) SJF preemptive

D) Multilevel feedback queue

Answer: A

34. In a system using global LRU replacement, increasing frames allocated to one process can:

A) Increase page faults for other processes (anomaly)

B) Always decrease total page faults

C) Eliminate thrashing

D) Cause deadlock

Answer: A

35. Which synchronization primitive is most suitable for a producer-consumer problem with multiple producers and consumers?

A) Two semaphores (empty & full) + one mutex

B) Only one counting semaphore

C) Monitor with condition variables

D) Spinlock only

Answer: C

36. In Linux, the default nice value range is:

A) -20 to +19

B) 0 to 99

C) -100 to +100

D) 1 to 40

Answer: A

37. The main advantage of delayed locking (or lock elision) in hardware transactional memory is:

A) Avoiding lock acquisition on uncontended paths

B) Guaranteeing progress

C) Preventing priority inversion

D) Reducing memory usage

Answer: A

38. In a system with 64-bit virtual address and 4 KB pages, how many levels are needed in a 4-level page table (x86-64 canonical addressing)?

A) 4 (PML4, PDPT, PD, PT)

B) 5

C) 3

D) 6

Answer: A

39. The Linux kernel uses which algorithm for page frame reclamation when memory is low?

A) Approximate LRU using active/inactive lists

B) Pure LRU

C) FIFO

D) Random

Answer: A

40. In a distributed system using vector clocks, the size of the vector is:

A) Equal to the number of processes

B) Logarithmic in number of processes

C) Fixed at 64 bits

D) Equal to number of events

Answer: A

41. Which of these is a correct statement about spinlocks vs. mutexes in Linux?

A) Spinlocks are preferred on multi-core systems for very short critical sections

B) Mutexes always spin

C) Spinlocks disable interrupts

D) Mutexes cannot cause priority inversion

Answer: A

42. In ext4, the extent tree replaces:

A) Indirect block pointers for large files

B) Inode direct pointers

C) Journal

D) Superblock

Answer: A

43. The main purpose of the Linux kernel's preempt_count is:

A) Track whether preemption is allowed (for nested interrupts, bottom halves, etc.)

B) Count number of processes

C) Measure CPU utilization

D) Track nice value

Answer: A

44. In a system using per-thread kernel stacks, the main advantage over single shared stack is:

A) Better security and no stack overflow propagation

B) Faster context switching

C) Less memory usage

D) Easier scheduling

Answer: A

45. Which page replacement policy can be implemented using a clock hand and reference bit?

A) Clock / Second-chance algorithm

B) LRU exactly

C) FIFO

D) Optimal

Answer: A

46. In Linux, the default I/O scheduler for SSDs has shifted to:

A) mq-deadline or none (for NVMe)

B) CFQ

C) Anticipatory

D) NOOP only

Answer: A

47. The main problem solved by seqlocks (sequence locks) in Linux is:

A) Allow readers to proceed without blocking writers for very fast read-mostly data

B) Prevent writers from starving

C) Replace RCU completely

D) Handle priority inversion

Answer: A

48. In a system with demand paging and a global page replacement policy, increasing the number of frames given to a process may lead to:

A) More page faults overall (stack algorithm property violation)

B) Fewer page faults always

C) No change in page faults

D) Deadlock

Answer: A

49. Which of these is true about Linux kernel preemption models?

A) PREEMPT_RT patch makes kernel fully preemptible for real-time guarantees

B) Voluntary preemption is the default in mainline

C) No preemption is used in servers

D) Preemption is disabled during system calls

Answer: A

50. In a system using hierarchical resource management (e.g., Linux cgroups), the main advantage of proportional share scheduling at each level is:

A) Predictable resource isolation and fairness across groups

B) Zero overhead

C) Guaranteed zero latency

D) Elimination of priority inversion

Answer: A

=== TOPIC: DBMS, LEVEL: easy ===

1. What does DBMS stand for?

A) Data Backup Management System

B) Database Management System

C) Data Base Memory System

D) Digital Base Management Service

Answer: B

2. The main purpose of a DBMS is to:

A) Store and manage data efficiently

B) Play music files

C) Design websites

D) Compile programs

Answer: A

3. Which of the following is an example of a DBMS?

A) Microsoft Word

B) MySQL

C) Google Chrome

D) Windows Paint

Answer: B

4. In a DBMS, data is organized in the form of:

A) Tables

B) Folders

C) Files only

D) Images

Answer: A

5. Which of these is NOT a function of DBMS?

A) Data storage

B) Data retrieval

C) Data encryption for all users

D) Data manipulation

Answer: C

6. The person who designs the database structure is called:

A) Database Administrator (DBA)

B) End User

C) Application Programmer

D) System Analyst

Answer: A

7. Which level of database abstraction shows only the required data to the user?

A) External level (View level)

B) Conceptual level

C) Physical level

D) Internal level

Answer: A

8. The physical storage details of data are hidden at which level?

A) External level

B) Conceptual level

C) Physical level

D) Logical level

Answer: A

9. DBMS provides:

A) Data independence

B) Data duplication

C) Data deletion only

D) Slow data access

Answer: A

10. Redundancy of data means:

A) Data is repeated unnecessarily

B) Data is stored only once

C) Data is deleted

D) Data is encrypted

Answer: A

11. In relational model, data is stored in:

A) Tables

B) Graphs

C) Trees

D) Lists

Answer: A

12. A row in a table is also called:

A) Tuple / Record

B) Attribute

C) Domain

D) Relation

Answer: A

13. A column in a table is also called:

A) Attribute / Field

B) Tuple

C) Key

D) Relation

Answer: A

14. A primary key is:

A) A unique identifier for each record

B) Can have duplicate values

C) Always NULL

D) Optional field

Answer: A

15. Which key is used to link two tables?

A) Foreign key

B) Candidate key

C) Super key

D) Composite key

Answer: A

16. A table can have:

A) Only one primary key

B) Multiple primary keys

C) No primary key

D) Only foreign keys

Answer: A

17. NULL in database means:

A) Value is unknown or not applicable

B) Zero value

C) Empty string

D) Special character

Answer: A

18. Which of the following is a valid SQL command type?

A) DDL, DML, DCL, TCL

B) Only SELECT

C) Only INSERT

D) Only UPDATE

Answer: A

19. Which SQL command is used to retrieve data?

A) SELECT

B) INSERT

C) UPDATE

D) DELETE

Answer: A

20. Which SQL command is used to add a new record?

A) INSERT

B) SELECT

C) DELETE

D) DROP

Answer: A

21. To remove a table from database we use:

A) DROP TABLE

B) DELETE TABLE

C) REMOVE TABLE

D) ERASE TABLE

Answer: A

22. To change the structure of a table we use:

A) ALTER TABLE

B) MODIFY TABLE

C) CHANGE TABLE

D) UPDATE TABLE

Answer: A

23. Which clause is used to filter records in SQL?

A) WHERE

B) GROUP BY

C) ORDER BY

D) HAVING

Answer: A

24. Which clause is used to sort the result?

A) ORDER BY

B) WHERE

C) GROUP BY

D) JOIN

Answer: A

25. Which command is used to modify existing records?

A) UPDATE

B) INSERT

C) DELETE

D) SELECT

Answer: A

26. To delete all rows from a table but keep the structure we use:

A) DELETE FROM table_name

B) DROP TABLE

C) TRUNCATE TABLE

D) REMOVE TABLE

Answer: C

27. Which of these is a DDL command?

A) CREATE TABLE

B) INSERT INTO

C) SELECT

D) UPDATE

Answer: A

28. Which is a DML command?

A) SELECT

B) CREATE

C) ALTER

D) DROP

Answer: A

29. COMMIT command belongs to:

A) TCL (Transaction Control Language)

B) DDL

C) DML

D) DCL

Answer: A

30. GRANT and REVOKE commands are part of:

A) DCL (Data Control Language)

B) DDL

C) DML

D) TCL

Answer: A

31. Which key can have NULL values?

A) Foreign key

B) Primary key

C) Unique key (in some cases)

D) Candidate key

Answer: A

32. A candidate key is:

A) Any attribute or set of attributes that can become primary key

B) Always the primary key

C) Foreign key only

D) Duplicate key

Answer: A

33. Which constraint does not allow duplicate values?

A) UNIQUE

B) PRIMARY KEY

C) FOREIGN KEY

D) Both A and B

Answer: D

34. Normalization is done to reduce:

A) Data redundancy

B) Data security

C) Query speed

D) Table size only

Answer: A

35. 1NF means:

A) No repeating groups, atomic values

B) No partial dependency

C) No transitive dependency

D) Boyce-Codd Normal Form

Answer: A

36. 2NF removes:

A) Partial dependency

B) Transitive dependency

C) Repeating groups

D) Multi-valued dependency

Answer: A

37. Which normal form removes transitive dependency?

A) 3NF

B) 1NF

C) 2NF

D) BCNF

Answer: A

38. A table is in BCNF if:

A) Every determinant is a candidate key

B) It is in 3NF

C) It has no primary key

D) It has only one attribute

Answer: A

39. Entity in ER model is represented by:

A) Rectangle

B) Diamond

C) Oval

D) Line

Answer: A

40. Relationship in ER diagram is shown by:

A) Diamond

B) Rectangle

C) Oval

D) Circle

Answer: A

41. RDBMS stands for:

A) Relational Database Management System

B) Remote Database Management System

C) Real-time Database Management System

D) Random Database Management System

Answer: A

42. Popular open-source RDBMS is:

A) MySQL

B) Oracle

C) MS SQL Server

D) DB2

Answer: A

43. Which of these is a NoSQL database?

A) MongoDB

B) MySQL

C) PostgreSQL

D) Oracle

Answer: A

44. ACID properties are related to:

A) Transactions

B) Normalization

C) Keys

D) Indexes

Answer: A

45. Which ACID property ensures that either all operations are completed or none are?

A) Atomicity

B) Consistency

C) Isolation

D) Durability

Answer: A

46. Which ACID property ensures committed data is permanently saved?

A) Durability

B) Atomicity

C) Consistency

D) Isolation

Answer: A

47. Index in database is used to:

A) Speed up data retrieval

B) Store data permanently

C) Delete data

D) Create tables

Answer: A

48. Primary key automatically creates:

A) Unique index

B) Clustered index (in many systems)

C) Both A and B

D) No index

Answer: C

49. Which command is used to create a new database?

A) CREATE DATABASE

B) NEW DATABASE

C) ADD DATABASE

D) MAKE DATABASE

Answer: A

50. The smallest unit of data in a database is:

A) Bit / Character

B) Record

C) Table

D) Schema

Answer: A

=== TOPIC: DBMS, LEVEL: medium ===

1. Which of the following is NOT a candidate key property?

A) Uniqueness

B) Minimality

C) Can contain NULL values

D) Irreducibility

Answer: C

2. A super key that contains no extra attributes is called:

A) Candidate key

B) Primary key

C) Foreign key

D) Composite key

Answer: A

3. In a relation, a foreign key can accept:

A) NULL values (if not specified otherwise)

B) Only values that exist in the referenced primary key

C) Duplicate values even if referenced column does not allow

D) Values not present in the referenced table

Answer: A & B (most accurate: A is allowed unless NOT NULL is specified)

4. Which constraint ensures that a column does not accept duplicate values but allows NULL?

A) UNIQUE

B) PRIMARY KEY

C) CHECK

D) NOT NULL

Answer: A

5. A table can have:

A) Multiple UNIQUE constraints

B) Only one PRIMARY KEY

C) Multiple FOREIGN KEYs

D) All of the above

Answer: D

6. Which of the following violates referential integrity?

A) Inserting a row with foreign key value not present in referenced table

B) Deleting a referenced primary key row without CASCADE

C) Updating primary key value that is referenced

D) All of the above

Answer: D

7. Composite key is:

A) A primary key made up of two or more attributes

B) A foreign key

C) A unique key with single attribute

D) A candidate key with NULL

Answer: A

8. A relation is in 2NF if it is in 1NF and:

A) Has no partial dependency

B) Has no transitive dependency

C) Has no multi-valued dependency

D) Every determinant is a candidate key

Answer: A

9. Transitive dependency occurs when:

A) Non-key attribute depends on another non-key attribute

B) Partial dependency on composite key

C) Multi-valued dependency exists

D) Key determines non-key directly

Answer: A

10. A relation is in 3NF if it is in 2NF and:

A) Has no transitive dependencies

B) Has no partial dependencies

C) All attributes are prime

D) Has no repeating groups

Answer: A

11. Boyce-Codd Normal Form (BCNF) is stricter than 3NF because:

A) Every determinant must be a candidate key

B) It removes partial dependencies

C) It removes multi-valued dependencies

D) It allows transitive dependencies

Answer: A

12. Which normal form deals with multi-valued dependencies?

A) 4NF

B) 3NF

C) BCNF

D) 2NF

Answer: A

13. Lossless decomposition is guaranteed if:

A) Common attribute is a superkey of at least one relation

B) Both relations are in 3NF

C) Decomposition is dependency preserving

D) Only if it is lossless-join

Answer: A

14. Dependency preservation means:

A) All functional dependencies can be enforced by checking individual relations

B) No information is lost after decomposition

C) Joins are always possible

D) Only primary keys are preserved

Answer: A

15. Which clause is used to eliminate duplicate rows in SELECT?

A) DISTINCT

B) UNIQUE

C) GROUP BY

D) ORDER BY

Answer: A

16. The HAVING clause is used with:

A) GROUP BY

B) WHERE

C) ORDER BY

D) JOIN

Answer: A

17. Which is the correct order of execution in SQL query?

A) FROM → WHERE → GROUP BY → HAVING → SELECT → ORDER BY

B) SELECT → FROM → WHERE → GROUP BY → HAVING → ORDER BY

C) WHERE → FROM → SELECT → GROUP BY → HAVING → ORDER BY

D) FROM → SELECT → WHERE → GROUP BY → HAVING → ORDER BY

Answer: A

18. Which JOIN returns all rows from left table and matching rows from right table?

A) LEFT OUTER JOIN

B) RIGHT OUTER JOIN

C) FULL OUTER JOIN

D) INNER JOIN

Answer: A

19. The difference between WHERE and HAVING is:

A) WHERE filters rows before grouping, HAVING filters after grouping

B) HAVING can use aggregate functions, WHERE cannot

C) WHERE cannot use aggregate functions, HAVING can

D) All of the above

Answer: D

20. To find the second highest salary from Employee table, which query is correct?

A) SELECT MAX(salary) FROM Employee WHERE salary < (SELECT MAX(salary) FROM Employee)

B) SELECT salary FROM Employee ORDER BY salary DESC LIMIT 1 OFFSET 1

C) Both A and B (depending on SQL dialect)

D) SELECT DISTINCT salary FROM Employee ORDER BY salary DESC LIMIT 1

Answer: C (A is standard, B is MySQL/PostgreSQL style)

21. Which function counts only non-NULL values?

A) COUNT(column_name)

B) COUNT(*)

C) SUM(column_name)

D) AVG(column_name)

Answer: A

22. Which ACID property ensures that a transaction is treated as a single unit?

A) Atomicity

B) Consistency

C) Isolation

D) Durability

Answer: A

23. Isolation level that prevents dirty reads but allows non-repeatable reads is:

A) READ COMMITTED

B) READ UNCOMMITTED

C) REPEATABLE READ

D) SERIALIZABLE

Answer: A

24. The isolation level that prevents phantom reads is:

A) SERIALIZABLE

B) REPEATABLE READ

C) READ COMMITTED

D) READ UNCOMMITTED

Answer: A

25. Which command ends a transaction by saving all changes permanently?

A) COMMIT

B) ROLLBACK

C) SAVEPOINT

D) SET TRANSACTION

Answer: A

26. A SAVEPOINT is used to:

A) Create a checkpoint within a transaction for partial rollback

B) Commit the transaction

C) Rollback entire transaction

D) Start a new transaction

Answer: A

27. Clustered index is also known as:

A) Table sort order / primary index

B) Non-unique index

C) Secondary index

D) Bitmap index

Answer: A

28. A view in SQL is:

A) A virtual table based on a query

B) A physical copy of data

C) A stored procedure

D) An index

Answer: A

29. Which operation is not allowed on a view without additional rules?

A) SELECT

B) INSERT (in some complex views)

C) UPDATE (in some complex views)

D) Both B and C

Answer: D

30. B-tree index is preferred over hash index when:

A) Range queries are frequent

B) Only equality searches are needed

C) Data is static

D) Table is very small

Answer: A

31. Which of the following is a disadvantage of indexing?

A) Increases space usage

B) Slows down INSERT/UPDATE/DELETE

C) Both A and B

D) None

Answer: C

32. Trigger in DBMS is:

A) A stored program executed automatically on certain events

B) A user-defined function

C) A view

D) An index

Answer: A

33. Which normal form is rarely used in practice due to its strictness?

A) 4NF / 5NF

B) 3NF

C) BCNF

D) 2NF

Answer: A

34. In ER model, cardinality 1:1 is represented as:

A) One-to-one relationship

B) One-to-many

C) Many-to-many

D) Many-to-one

Answer: A

35. Weak entity set depends on:

A) Strong/regular entity set (identifying relationship)

B) Another weak entity

C) Primary key only

D) Foreign key only

Answer: A

36. Which SQL keyword is used to rename a column in output?

A) AS

B) RENAME

C) ALIAS

D) CHANGE

Answer: A

37. Subquery that returns multiple rows is used with:

A) IN, ANY, ALL

B) = only

C) BETWEEN only

D) LIKE only

Answer: A

38. Correlated subquery is executed:

A) Once for each row of outer query

B) Only once

C) Never

D) Before outer query

Answer: A

39. Which join is equivalent to INNER JOIN + rows from both tables with no match?

A) FULL OUTER JOIN

B) LEFT JOIN

C) RIGHT JOIN

D) CROSS JOIN

Answer: A

40. The default sort order in ORDER BY is:

A) ASC (ascending)

B) DESC

C) Random

D) No order

Answer: A

41. Which clause is used to group rows with same values?

A) GROUP BY

B) HAVING

C) WHERE

D) DISTINCT

Answer: A

42. UNION operator:

A) Removes duplicates by default

B) Keeps duplicates

C) Only works on same number of columns

D) Both A and C

Answer: D

43. Which is faster generally?

A) Index seek

B) Table scan

C) Index scan (range)

D) Full table scan on small table

Answer: A

44. Deadlock in DBMS can occur when:

A) Two transactions wait for each other’s locks forever

B) Only one transaction locks

C) No locks are used

D) Isolation level is READ UNCOMMITTED

Answer: A

45. Which recovery technique uses logs to redo committed transactions?

A) Redo (forward recovery)

B) Undo

C) Checkpoint

D) Shadow paging

Answer: A

46. Shadow paging is a:

A) Recovery technique that avoids logging

B) Logging technique

C) Concurrency control method

D) Normalization method

Answer: A

47. Which concurrency control technique uses timestamps?

A) Timestamp ordering protocol

B) Two-phase locking

C) Optimistic concurrency control

D) All of the above

Answer: A

48. Two-phase locking ensures:

A) Serializability

B) Deadlock freedom

C) No cascading rollback

D) High performance always

Answer: A

49. Cascading rollback is avoided in:

A) Strict two-phase locking

B) Basic two-phase locking

C) Timestamp protocol

D) Optimistic control

Answer: A

50. Which of the following is a NoSQL database category?

A) Document store (e.g., MongoDB)

B) Key-value store

C) Column-family store

D) All of the above

Answer: D

=== TOPIC: DBMS, LEVEL: hard ===

1. Which of the following is true about BCNF but not necessarily about 3NF?

A) Every non-trivial functional dependency has a candidate key on the left side

B) It eliminates all transitive dependencies

C) It allows transitive dependencies if determinant is prime

D) It is always dependency preserving when decomposed

Answer: A

2. A relation R(A,B,C,D) with FDs: A→B, BC→D, D→C is in:

A) 3NF but not BCNF

B) BCNF

C) 2NF but not 3NF

D) 1NF only

Answer: A (D→C violates BCNF since D is not superkey)

3. In a relation with multi-valued dependency A →→ B, C, the relation is in:

A) 4NF only if it is also in BCNF and has no non-trivial MVDs

B) BCNF automatically

C) 3NF automatically

D) 2NF automatically

Answer: A

4. Which normal form requires that there are no non-trivial join dependencies except those implied by candidate keys?

A) 5NF (Project-Join Normal Form)

B) 4NF

C) BCNF

D) DKNF (Domain-Key Normal Form)

Answer: A

5. Lossless-join decomposition into BCNF is always:

A) Possible but not always dependency preserving

B) Dependency preserving

C) Both lossless and dependency preserving

D) Impossible if relation is not already in BCNF

Answer: A

6. In strict two-phase locking (Strict 2PL), locks are released:

A) Only after commit or abort (no early release)

B) After growing phase

C) During shrinking phase before commit

D) Immediately after use

Answer: A

7. Which concurrency control protocol can suffer from cascading aborts?

A) Basic 2PL

B) Strict 2PL

C) Conservative 2PL

D) Timestamp ordering

Answer: A

8. In Thomas Write Rule (used in basic timestamp ordering), if TS(T) < W-timestamp(X):

A) Write is ignored (Thomas' write rule)

B) Transaction is aborted

C) Write is allowed

D) X is locked until later

Answer: A

9. The phenomenon where a transaction reads two different values for the same row in two reads due to an update by another committed transaction is called:

A) Non-repeatable read

B) Phantom read

C) Dirty read

D) Lost update

Answer: A

10. Snapshot isolation prevents:

A) All write-write conflicts via first-committer-wins

B) All read-write conflicts

C) Phantom reads completely

D) Dirty reads only

Answer: A (but allows write skew anomaly)

11. Which isolation level is prone to write skew anomaly?

A) Snapshot Isolation

B) Serializable

C) Repeatable Read

D) Read Committed

Answer: A

12. In optimistic concurrency control, the validation phase checks:

A) Whether the transaction's reads could have been affected by concurrent committed transactions

B) Only write conflicts

C) Lock conflicts

D) Timestamp order

Answer: A

13. In ARIES recovery algorithm, the Analysis phase:

A) Scans the log from last checkpoint to build Dirty Page Table and Transaction Table

B) Redoes all operations

C) Undoes all uncommitted transactions

D) Ignores checkpoints

Answer: A

14. The purpose of Compensation Log Records (CLRs) in ARIES is:

A) To allow undo operations to be redone idempotently

B) To redo committed transactions

C) To checkpoint frequently

D) To store before-images only

Answer: A

15. In write-ahead logging (WAL), a log record must be flushed to disk:

A) Before the corresponding data page is written

B) After the data page is written

C) Only at commit

D) Only during checkpoint

Answer: A

16. Force policy in recovery means:

A) All modified pages are written to disk at commit

B) Pages can be written anytime

C) No pages are written at commit

D) Only undo logs are forced

Answer: A

17. Which recovery technique does not require undo logs for committed transactions?

A) Shadow paging

B) Deferred update (NO-UNDO/REDO)

C) Immediate update (UNDO/REDO)

D) ARIES

Answer: B

18. In cost-based query optimization, the main factor for choosing join order is:

A) Size of intermediate results

B) Number of joins only

C) Type of join (hash vs nested-loop) only

D) Availability of indexes only

Answer: A

19. Hash join is most efficient when:

A) One relation is small enough to fit in memory (build phase)

B) Both relations are very large

C) Join predicate is inequality

D) No sorting is required

Answer: A

20. Covering index means:

A) Index contains all columns needed by query (no table access required)

B) Index covers entire table

C) Clustered index

D) Composite index with primary key

Answer: A

21. Bitmap index is most suitable for:

A) Columns with low cardinality (few distinct values)

B) High-cardinality columns

C) Range queries only

D) Primary key columns

Answer: A

22. In B+ tree, all data records are stored:

A) Only at leaf level (in most implementations)

B) At every level

C) Only at root

D) In internal nodes

Answer: A

23. In distributed databases, the two-phase commit protocol can lead to:

A) Blocking if coordinator fails after prepare phase

B) No blocking ever

C) Inconsistent state always

D) No need for participants

Answer: A

24. Which of the following is NOT a CAP theorem guarantee that can be fully achieved simultaneously in a distributed system?

A) Consistency, Availability, Partition tolerance — any two

B) All three simultaneously

C) Only Consistency and Partition tolerance

D) Only Availability and Partition tolerance

Answer: B

25. In eventual consistency model (BASE), the system guarantees:

A) Replicas will converge to the same value eventually if no new updates

B) Immediate consistency

C) Serializability always

D) ACID properties

Answer: A

26. Write skew anomaly in snapshot isolation is an example of:

A) Non-serializable but conflict-serializable schedule

B) Conflict-serializable but not view-serializable

C) Serial schedule

D) Recoverable schedule only

Answer: A

27. Which concurrency control method is used by PostgreSQL by default?

A) Multi-version concurrency control (MVCC)

B) Strict 2PL

C) Timestamp ordering

D) Optimistic with locking

Answer: A

28. In MVCC, a transaction reads the version of a row that was:

A) Committed before the transaction started (snapshot)

B) Latest version always

C) Written by itself only

D) Visible according to isolation level

Answer: A (in repeatable read / snapshot isolation)

29. The phantom problem is solved in:

A) Serializable isolation level (via predicate locking or index locking)

B) Repeatable read (in some systems)

C) Read committed

D) Read uncommitted

Answer: A

30. Which of the following is a correct statement about SQL standard isolation levels?

A) Repeatable Read prevents non-repeatable reads but may allow phantoms

B) Serializable prevents phantoms but allows dirty reads

C) Read Committed prevents dirty reads but allows phantoms

D) Snapshot Isolation is part of SQL standard

Answer: A

(Continuing to 50 — remaining questions cover deeper theory, decomposition, cost models, etc.)

31. A schedule is conflict serializable if:

A) Its precedence graph is acyclic

B) It is equivalent to a serial schedule in reads and writes

C) It has no cycles in view graph

D) It has no dirty reads

Answer: A

32. View serializability is stricter than:

A) Conflict serializability

B) Recoverability

C) Cascade-less property

D) Rigorous scheduling

Answer: A (view-serializable $\subset$ conflict-serializable)

33. In query processing, the most expensive operation is usually:

A) Cartesian product (cross join)

B) Selection

C) Projection

D) Sorting

Answer: A

34. Selinger-style dynamic programming in query optimization is used for:

A) Join order enumeration

B) Index selection only

C) Cost estimation only

D) Predicate pushdown

Answer: A

35. In a relation R(A,B,C) with FDs A→B, B→C, the minimal cover is:

A) A→B, A→C

B) A→B, B→C

C) A→BC

D) A→C only

Answer: B (minimal cover keeps original FDs if possible)

36. In checkpoint-based recovery, fuzzy checkpoint allows:

A) Updates during checkpoint without blocking writers

B) Only read-only during checkpoint

C) Immediate flush of all dirty pages

D) No log records during checkpoint

Answer: A

37. Which protocol guarantees recoverable schedules?

A) Strict 2PL

B) Rigorous 2PL

C) ACA (avoids cascading aborts)

D) All of the above

Answer: D

38. The number of conflict-serializable schedules for n transactions is:

A) Much larger than serial schedules

B) Equal to number of serial schedules

C) Always less than serial schedules

D) Exactly n!

Answer: A

39. In distributed 2PL, deadlock detection is:

A) More complex due to no global wait-for graph easily available

B) Simpler than centralized

C) Not required

D) Done only at coordinator

Answer: A

40. Which of these is NOT a property of 3NF synthesis algorithm?

A) Always dependency preserving

B) Always lossless join

C) May produce relations not in BCNF

D) Produces minimal number of relations

Answer: B (3NF synthesis is dependency preserving but not always lossless)

41. In temporal databases, valid time vs transaction time difference is:

A) Valid time = when fact is true in real world; transaction time = when recorded in DB

B) Both are same

C) Valid time is recorded time

D) Transaction time is user-provided

Answer: A

42. In spatial databases, R-tree is used for:

A) Indexing multi-dimensional data (rectangles, points)

B) B+ tree variant for 1D

C) Hash-based indexing

D) Bitmap indexing

Answer: A

43. Column-oriented storage (column stores) is most beneficial for:

A) Analytical queries (aggregation over few columns)

B) OLTP with frequent updates

C) Point queries only

D) Full row scans always

Answer: A

44. In LSM-tree (used in LevelDB, RocksDB, Cassandra), the main write path is:

A) Write to memory table → immutable memtable → SSTables on disk

B) Direct write to disk B-tree

C) In-place update

D) Shadow paging

Answer: A

45. Which of the following concurrency anomalies is possible in Repeatable Read but not in Snapshot Isolation?

A) Write skew

B) Phantom read

C) Non-repeatable read

D) Dirty read

Answer: B (in some implementations; depends on exact definition)

46. The purpose of index-organized table (IOT) in Oracle / clustered index in SQL Server is:

A) Store entire row in leaf nodes of index (no heap)

B) Store only pointers

C) Allow duplicate keys

D) Reduce space for non-key columns

Answer: A

47. In query rewriting, predicate pushdown refers to:

A) Moving selection predicates down the query tree closer to base relations

B) Pushing joins up

C) Removing redundant predicates

D) Converting subqueries to joins

Answer: A

48. Which isolation level is default in most commercial databases for OLTP?

A) Read Committed

B) Serializable

C) Repeatable Read

D) Snapshot

Answer: A

49. In multiversion timestamp ordering, each write creates:

A) A new version with higher write timestamp

B) Overwrites old version

C) Locks the version

D) Aborts previous writers

Answer: A

50. Which of the following is a correct statement about serializability in distributed databases?

A) Global serializability requires local serializability + additional constraints (e.g., commitment ordering)

B) Local serializability is sufficient

C) No global serializability needed

D) Timestamp ordering guarantees global serializability always

Answer: A

=== TOPIC: Oops, LEVEL: easy ===

1. What does OOP stand for?

A) Object-Oriented Programming

B) Operational Oriented Programming

C) Object Only Programming

D) Organized Object Programming

Answer: A

2. Which of the following is the main pillar of OOP?

A) Inheritance

B) Encapsulation

C) Polymorphism

D) All of the above

Answer: D

3. An object is an instance of a:

A) Class

B) Method

C) Variable

D) Loop

Answer: A

4. A class is a:

A) Blueprint for creating objects

B) Running program

C) Data type only

D) Function only

Answer: A

5. Which concept hides the internal details and shows only the necessary features?

A) Encapsulation

B) Inheritance

C) Polymorphism

D) Abstraction

Answer: D

6. Bundling data and methods that operate on the data into a single unit is called:

A) Encapsulation

B) Inheritance

C) Polymorphism

D) Abstraction

Answer: A

7. The process by which one class acquires the properties of another class is called:

A) Inheritance

B) Polymorphism

C) Encapsulation

D) Abstraction

Answer: A

8. The ability of different objects to respond to the same message in different ways is called:

A) Polymorphism

B) Inheritance

C) Encapsulation

D) Abstraction

Answer: A

9. In OOP, real-world entities are represented as:

A) Objects

B) Functions

C) Variables

D) Arrays

Answer: A

10. Which of these is NOT a pillar of OOP?

A) Recursion

B) Inheritance

C) Polymorphism

D) Encapsulation

Answer: A

11. In Java, the keyword used to create a class is:

A) class

B) Class

C) define

D) struct

Answer: A

12. To create an object of a class in Java, we use:

A) new keyword

B) create keyword

C) object keyword

D) instance keyword

Answer: A

13. Instance variables are also called:

A) Object variables

B) Class variables

C) Static variables

D) Local variables

Answer: A

14. Which keyword is used to refer to the current object in Java?

A) this

B) self

C) current

D) me

Answer: A

15. In Python, the first parameter of every instance method is:

A) self

B) this

C) obj

D) instance

Answer: A

16. The most restrictive access specifier in Java is:

A) private

B) protected

C) public

D) default

Answer: A

17. Which access modifier allows access only within the same class?

A) private

B) protected

C) public

D) default

Answer: A

18. Data members declared as private are accessible:

A) Only inside the class

B) From anywhere

C) From child classes only

D) From same package only

Answer: A

19. Getter and setter methods are used to achieve:

A) Encapsulation

B) Inheritance

C) Polymorphism

D) Abstraction

Answer: A

20. Which of these provides data hiding?

A) private members

B) public members

C) protected members

D) default members

Answer: A

21. The class that is inherited is called:

A) Superclass / Base class / Parent class

B) Subclass

C) Child class

D) Derived class

Answer: A

22. The class that inherits is called:

A) Subclass / Derived class / Child class

B) Superclass

C) Base class

D) Parent class

Answer: A

23. In Java, single inheritance is achieved using:

A) extends keyword

B) implements keyword

C) inherit keyword

D) super keyword

Answer: A

24. Which inheritance is supported by Java for classes?

A) Single inheritance

B) Multiple inheritance

C) Multilevel inheritance

D) Hierarchical inheritance

Answer: A (Java classes support single inheritance only)

25. Which keyword is used to call the parent class constructor in Java?

A) super

B) this

C) parent

D) base

Answer: A

26. Compile-time polymorphism is achieved by:

A) Method overloading

B) Method overriding

C) Operator overloading

D) Both A and C

Answer: D

27. Run-time polymorphism is achieved by:

A) Method overriding

B) Method overloading

C) Constructor overloading

D) Operator overloading

Answer: A

28. Method overloading means:

A) Same method name with different parameters

B) Same method name in child class

C) Different method name with same parameters

D) Same method in different classes

Answer: A

29. Method overriding requires:

A) Inheritance

B) Same method name and parameters

C) Same return type (or covariant)

D) All of the above

Answer: D

30. Which concept allows one interface to be used for different types?

A) Polymorphism

B) Encapsulation

C) Inheritance

D) Abstraction

Answer: A

31. Which keyword is used to achieve abstraction in Java?

A) abstract

B) interface

C) final

D) static

Answer: A

32. An abstract class can have:

A) Both abstract and concrete methods

B) Only abstract methods

C) Only concrete methods

D) No methods

Answer: A

33. An interface in Java can have (before Java 8):

A) Only abstract methods

B) Concrete methods

C) Instance variables

D) Constructors

Answer: A

34. A class that implements an interface must provide implementation for:

A) All abstract methods

B) Only some methods

C) No methods

D) Only constructors

Answer: A

35. Which keyword is used by a class to implement an interface?

A) implements

B) extends

C) inherit

D) use

Answer: A

36. The process of creating an object is called:

A) Instantiation

B) Declaration

C) Definition

D) Initialization

Answer: A

37. Which of these is used to prevent inheritance?

A) final keyword (for class)

B) static keyword

C) abstract keyword

D) interface keyword

Answer: A

38. Static members belong to:

A) Class

B) Object

C) Method

D) Interface

Answer: A

39. A constructor has:

A) Same name as class

B) No return type

C) Can be overloaded

D) All of the above

Answer: D

40. Default constructor is provided by compiler if:

A) No constructor is defined

B) Parameterized constructor is defined

C) Abstract class is used

D) Final class is used

Answer: A

41. Which of these cannot be inherited?

A) Private members

B) Public members

C) Protected members

D) Default members

Answer: A

42. super keyword is used to:

A) Refer to immediate parent class

B) Refer to current class

C) Create object

D) Define static method

Answer: A

43. final method means:

A) Cannot be overridden

B) Cannot be overloaded

C) Must be overridden

D) Can be changed

Answer: A

44. Which of these supports multiple inheritance in Java?

A) Interface

B) Class

C) Abstract class

D) Final class

Answer: A

45. Object class is the:

A) Superclass of all classes in Java

B) Subclass of String

C) Interface

D) Abstract class

Answer: A

46. toString() method belongs to:

A) Object class

B) String class

C) Math class

D) System class

Answer: A

47. equals() method is used to compare:

A) Content of objects

B) References only

C) Memory address only

D) Class name

Answer: A (when overridden)

48. Which concept is used in method overriding?

A) Run-time polymorphism

B) Compile-time polymorphism

C) Encapsulation

D) Abstraction

Answer: A

49. A class can extend:

A) Only one class (in Java)

B) Multiple classes

C) No class

D) Only interfaces

Answer: A

50. Which of these is an example of real-world abstraction?

A) Using a TV remote without knowing internal circuits

B) Writing code inside class

C) Inheriting properties

D) Overloading methods

Answer: A

=== TOPIC: Oops, LEVEL: medium ===

1. Which of the following is true about constructors in Java?

A) They can have a return type

B) They must have the same name as the class

C) They can be final

D) They are inherited by subclasses

Answer: B

2. If a class has no constructor defined explicitly, the compiler provides:

A) A default no-argument constructor

B) A parameterized constructor

C) No constructor at all

D) A copy constructor

Answer: A

3. Which keyword is used to call another constructor of the same class?

A) this()

B) super()

C) new

D) init

Answer: A

4. super() must be the:

A) First statement in a constructor

B) Last statement in a constructor

C) Can be anywhere

D) Not used in constructors

Answer: A

5. Which of these cannot be used to initialize instance variables?

A) Instance initializer block

B) Constructor

C) Static initializer block

D) Both A and B

Answer: C

6. A class can have:

A) Multiple constructors (constructor overloading)

B) Only one constructor

C) No constructors

D) Both A and C

Answer: D

7. Which members of a superclass are NOT inherited by a subclass in Java?

A) private members

B) public members

C) protected members

D) default members (same package)

Answer: A

8. A subclass can access protected members of the superclass:

A) Only within the same package

B) From any package through inheritance

C) Only if subclass is in same package

D) Never

Answer: B

9. Which of the following is true about method overriding?

A) Return type must be exactly the same or covariant

B) Parameter list can be different

C) Method name can be different

D) Access modifier can be more restrictive

Answer: A

10. Which access modifier allows access in the same class, same package, and subclasses (even in different packages)?

A) protected

B) private

C) public

D) default

Answer: A

11. final class means:

A) Cannot be subclassed

B) All methods are final

C) Cannot be instantiated

D) All variables are final

Answer: A

12. A final method can be:

A) Overloaded but not overridden

B) Overridden but not overloaded

C) Neither overloaded nor overridden

D) Only static

Answer: A

13. Which type of binding is used in method overriding?

A) Dynamic / Late binding

B) Static / Early binding

C) Compile-time binding

D) No binding

Answer: A

14. Which of the following calls is resolved at compile time?

A) Method overloading

B) Method overriding

C) Virtual method call

D) Interface method call

Answer: A

15. In Java, if a superclass reference points to a subclass object, then calling an overridden method will invoke:

A) Subclass version

B) Superclass version

C) Both

D) Compilation error

Answer: A

16. Which of these supports compile-time polymorphism?

A) Method overloading

B) Method overriding

C) Operator overloading (in C++)

D) Both A and C

Answer: D

17. What happens if we try to override a static method?

A) It is method hiding, not overriding

B) Compilation error

C) Runtime error

D) Works as overriding

Answer: A

18. private methods can be:

A) Overridden

B) Hidden

C) Neither overridden nor hidden

D) Overloaded only

Answer: C

19. An abstract class can have:

A) Concrete methods

B) Abstract methods

C) Constructors

D) All of the above

Answer: D

20. An interface (before Java 8) can contain:

A) Only abstract methods and constants

B) Concrete methods

C) Instance variables (non-final)

D) Constructors

Answer: A

21. From Java 8 onwards, interfaces can have:

A) default methods

B) static methods

C) Both A and B

D) Instance methods

Answer: C

22. A class can:

A) Extend one class and implement multiple interfaces

B) Extend multiple classes

C) Implement multiple abstract classes

D) Extend multiple interfaces

Answer: A

23. If two interfaces have the same default method, the implementing class must:

A) Override the method

B) Not implement either

C) Use super keyword to choose one

D) Compilation error unless overridden

Answer: D (unless it overrides)

24. Which keyword is used to provide implementation of an interface method?

A) @Override

B) implements

C) default

D) override

Answer: A (annotation, but required for clarity)

25. The toString() method is defined in:

A) Object class

B) String class

C) System class

D) Class class

Answer: A

26. equals() method in Object class compares:

A) Object references

B) Object contents

C) Hash codes

D) Class names

Answer: A

27. If you override equals(), you should also override:

A) hashCode()

B) toString()

C) clone()

D) finalize()

Answer: A

28. The clone() method is declared in:

A) Object class

B) Cloneable interface

C) Serializable interface

D) Comparable interface

Answer: A

29. Which of these is a marker interface?

A) Cloneable

B) Comparable

C) Serializable

D) Both A and C

Answer: D

30. instanceof operator is used to check:

A) Type compatibility at runtime

B) Reference equality

C) Value equality

D) Class equality

Answer: A

31. Upcasting is:

A) Assigning subclass object to superclass reference

B) Assigning superclass object to subclass reference

C) Explicit type casting

D) Implicit type casting from subclass to superclass

Answer: A & D

32. Downcasting requires:

A) Explicit type cast

B) Implicit type cast

C) No cast

D) Compilation error always

Answer: A

33. Which of these can be declared inside an interface? (Java 8+)

A) private methods

B) static methods

C) default methods

D) All of the above

Answer: D

34. A nested class declared static is called:

A) Static nested class

B) Inner class

C) Local class

D) Anonymous class

Answer: A

35. An anonymous class is:

A) A class without a name

B) Declared and instantiated at the same time

C) Usually used for one-time use

D) All of the above

Answer: D

36. Which of these is true about inner classes?

A) Can access private members of outer class

B) Cannot be static

C) Must be public

D) Cannot have constructors

Answer: A

37. The this keyword refers to:

A) Current instance of the class

B) Superclass instance

C) Static context

D) Interface instance

Answer: A

38. static methods can be called using:

A) Class name

B) Object reference

C) Both A and B

D) Only through inheritance

Answer: C

39. Which of these cannot be declared static?

A) Methods

B) Variables

C) Classes (top-level)

D) Nested classes

Answer: C

40. A static block is executed:

A) When the class is loaded

B) When an object is created

C) Every time method is called

D) When main method runs

Answer: A

41. Which of these is true about garbage collection in Java?

A) finalize() method is called before object is garbage collected

B) finalize() is guaranteed to run

C) Developer can force garbage collection

D) finalize() is deprecated in Java 9+

Answer: A & D (deprecated but still relevant in many questions)

42. Which access modifier is default (no keyword) in Java?

A) package-private

B) protected

C) public

D) private

Answer: A

43. In method overriding, if superclass throws checked exception, subclass can throw:

A) Same or narrower checked exception

B) Broader checked exception

C) Any unchecked exception

D) Both A and C

Answer: D

44. Covariant return type in overriding means:

A) Subclass method can return subtype of superclass return type

B) Return type must be exactly same

C) Return type can be wider

D) Not allowed in Java

Answer: A

45. Which of these is true about abstract methods?

A) Cannot have body

B) Must be overridden in non-abstract subclass

C) Can be private

D) Both A and B

Answer: D (private abstract methods allowed but must be overridden in inner classes)

46. Which pattern uses composition over inheritance?

A) Strategy pattern

B) Decorator pattern

C) Both A and B

D) Singleton pattern

Answer: C

47. The diamond problem occurs in:

A) Multiple inheritance of classes

B) Multiple inheritance of interfaces

C) Single inheritance

D) Hybrid inheritance

Answer: A (Java avoids it by not supporting multiple class inheritance)

48. In Java, default methods in interfaces help solve:

A) Backward compatibility when adding new methods

B) Diamond problem completely

C) Multiple inheritance issues

D) Static method conflicts

Answer: A

49. Which of these is a correct way to prevent method overriding?

A) Declare method as final

B) Declare class as final

C) Make method private

D) All of the above

Answer: D

50. Runtime polymorphism is also known as:

A) Dynamic method dispatch

B) Static binding

C) Early binding

D) Compile-time polymorphism

Answer: A

=== TOPIC: Oops, LEVEL: hard ===

1. In Java, if a superclass method declares a checked exception and the overriding method in subclass declares no exception, is it allowed?

A) Yes

B) No — must declare same or narrower checked exceptions

C) Yes only if subclass method throws unchecked

D) Compilation error always

Answer: A

2. What happens when you attempt to override a final method?

A) Compilation error

B) Method hiding occurs

C) Runtime exception

D) It becomes overloaded instead

Answer: A

3. In Java, covariant return types allow overriding methods to return:

A) A subtype of the return type declared in the superclass

B) A supertype of the return type

C) Any type (unchecked cast internally)

D) Only primitive types

Answer: A

4. Which of the following causes the diamond problem in multiple inheritance?

A) Ambiguity in method resolution when two parent classes have the same method

B) Ambiguity in field access

C) Both A and B

D) Only constructor ambiguity

Answer: C

5. In C++, virtual inheritance is used to solve:

A) Diamond problem by ensuring only one instance of the common base class

B) Multiple inheritance of interfaces

C) Pure virtual function conflicts

D) Constructor chaining issues

Answer: A

6. In Java 8+, if two interfaces declare the same default method, and a class implements both, what happens?

A) Compilation error unless the class overrides the method

B) The method from the first interface is chosen

C) Runtime error

D) Both methods are available via super

Answer: A

7. Which keyword in C++ makes a base class method inaccessible in derived classes unless explicitly brought into scope?

A) private inheritance

B) protected inheritance

C) using directive

D) virtual inheritance

Answer: A (private inheritance hides all base members)

8. In C++, if a class has a virtual destructor, what is the main reason?

A) To ensure proper cleanup of derived class objects when deleted via base pointer

B) To allow overriding of destructor

C) To prevent object slicing

D) To make class abstract

Answer: A

9. In Java, what is the order of execution when creating a subclass object?

A) Superclass static → Subclass static → Superclass instance → Superclass constructor → Subclass instance → Subclass constructor

B) Superclass static → Subclass static → Superclass constructor → Subclass constructor → instance blocks

C) Static blocks first (super then sub), then constructors (super then sub), instance blocks interleaved

D) All constructors first, then static blocks

Answer: C (static blocks of super before sub, instance initializers run before constructor body)

10. In Java, if a constructor calls an overridable method before subclass constructor completes, what can happen?

A) Subclass version is called (even though object is not fully initialized) → fragile base class problem

B) Superclass version is always called

C) Compilation error

D) NullPointerException always

Answer: A

11. In C++, object slicing occurs when:

A) A derived object is assigned to a base object (by value)

B) A base pointer points to derived object

C) Virtual functions are called

D) Multiple inheritance is used

Answer: A

12. In Java, static methods exhibit:

A) Early binding (resolved at compile time)

B) Late binding

C) No binding

D) Dynamic dispatch

Answer: A

13. Which of these supports true multiple dispatch (choosing method based on runtime type of more than one argument)?

A) Java (via visitor pattern)

B) C++ (native)

C) Common Lisp (multimethods)

D) Python (native)

Answer: C

14. In C++, a pure virtual function with implementation is called:

A) Virtual function with definition

B) Pure virtual function (still abstract)

C) Final function

D) Default implementation

Answer: B (class remains abstract)

15. In Java, what is the behavior when calling a method on a null reference?

A) NullPointerException at runtime

B) Compilation error if method is instance

C) Static methods can be called on null reference

D) Both A and C

Answer: D

16. The Liskov Substitution Principle (LSP) is violated when:

A) A subclass throws a new checked exception not declared in superclass

B) A subclass strengthens preconditions or weakens postconditions

C) A subclass changes the meaning of an operation significantly

D) All of the above

Answer: D

17. Which design pattern uses composition to add responsibilities dynamically?

A) Decorator

B) Strategy

C) Observer

D) Factory Method

Answer: A

18. The Open-Closed Principle states that classes should be:

A) Open for extension, closed for modification

B) Closed for extension, open for modification

C) Open for both

D) Closed for both

Answer: A

19. In the Visitor pattern, the main advantage is:

A) Adding new operations without changing element classes

B) Reducing coupling between classes

C) Avoiding multiple inheritance

D) Implementing double dispatch

Answer: A

20. Which SOLID principle is most directly violated by a "God class"?

A) Single Responsibility Principle

B) Interface Segregation Principle

C) Dependency Inversion Principle

D) Open-Closed Principle

Answer: A

21. In Java, when should you override hashCode() if you override equals()?

A) Always — to maintain the contract

B) Only if using in HashMap

C) Never — default is fine

D) Only for immutable objects

Answer: A

22. The default implementation of equals() in Object compares:

A) Object identity (==)

B) Field values

C) Class name

D) Hash code

Answer: A

23. In Java, clone() method by default performs:

A) Shallow copy

B) Deep copy

C) No copy — throws exception

D) Field-by-field copy including references

Answer: A

24. To perform a deep copy using clone(), you must:

A) Override clone() and clone referenced objects recursively

B) Implement Serializable

C) Use copy constructor

D) Use clone() directly

Answer: A

25. finalize() method in Java is:

A) Called by garbage collector before reclaiming object (deprecated since Java 9)

B) Guaranteed to run

C) Used for resource cleanup (not recommended anymore)

D) Both A and C

Answer: D

26. In Java, can you override a static method?

A) No — it results in method hiding

B) Yes — dynamic dispatch

C) Only if final

D) Only in interfaces

Answer: A

27. In C++, a class with at least one pure virtual function is:

A) Abstract (cannot be instantiated)

B) Concrete

C) Final

D) Static

Answer: A

28. In Java, what is the output when a subclass overrides toString() but you call it on a superclass reference?

A) Subclass version (polymorphism)

B) Superclass version

C) Compilation error

D) Object's default

Answer: A

29. In C++, if a base class destructor is not virtual and you delete a derived object via base pointer:

A) Undefined behavior (only base destructor called)

B) Both destructors called

C) Compilation error

D) Only derived destructor called

Answer: A

30. In Java, enum types implicitly extend:

A) java.lang.Enum

B) java.lang.Object

C) java.io.Serializable

D) All of the above

Answer: A

(Continuing to 50 — remaining questions cover generics, lambdas, reflection, inner classes, etc.)

31. In Java generics, type erasure means:

A) Generic type information is removed at compile time

B) Runtime checks are always performed

C) Generics are reified

D) Primitive types cannot be used

Answer: A

32. Which of these is illegal in Java generics?

A) List<?>

B) List<? extends Number>

C) List<? super Integer>

D) List<int>

Answer: D

33. The getClass() method returns:

A) The runtime class of the object

B) The compile-time type

C) The superclass

D) The interface

Answer: A

34. In Java, anonymous inner classes can access:

A) final or effectively final local variables

B) Only static variables

C) Any local variable

D) Only instance variables

Answer: A

35. In C++, RAII stands for:

A) Resource Acquisition Is Initialization

B) Runtime Allocation Is Immediate

C) Resource Access Is Inherited

D) Return All In Initialization

Answer: A

36. Which pattern is used when you need only one instance of a class?

A) Singleton

B) Prototype

C) Builder

D) Adapter

Answer: A

37. In Java, record classes (Java 16+) are implicitly:

A) final, immutable, with private final fields

B) abstract

C) mutable

D) extendable

Answer: A

38. The bridge method in Java generics is created to:

A) Support binary compatibility with legacy non-generic code

B) Prevent type erasure

C) Allow primitive generics

D) Optimize performance

Answer: A

39. In C++, CRTP (Curiously Recurring Template Pattern) is used for:

A) Static polymorphism / compile-time dispatch

B) Runtime polymorphism

C) Multiple inheritance

D) Memory management

Answer: A

40. Which of these violates the Interface Segregation Principle?

A) A fat interface with methods not needed by all clients

B) Many small interfaces

C) Dependency inversion

D) Abstract factory

Answer: A

41. In Java, lambdas are implemented using:

A) invokedynamic + synthetic methods

B) Anonymous inner classes only

C) Reflection

D) Native code

Answer: A

42. Which method must be implemented by classes that implement Comparable?

A) compareTo()

B) equals()

C) hashCode()

D) toString()

Answer: A

43. In C++, move semantics (rvalue references) are primarily used to:

A) Avoid unnecessary copying of resources

B) Enable polymorphism

C) Support multiple inheritance

D) Prevent object slicing

Answer: A

44. In Java, what is the default visibility of interface methods (Java 9+ private methods)?

A) private

B) public

C) protected

D) package-private

Answer: A

45. Which of these is a correct statement about sealed classes (Java 17+)?

A) Restrict which classes can extend/implement them

B) Make all subclasses final

C) Prevent overriding

D) Allow only private subclasses

Answer: A

46. The prototype pattern is most useful when:

A) Object creation is expensive and you need copies

B) You need only one instance

C) You need runtime method selection

D) You need dynamic responsibilities

Answer: A

47. In Java, what happens if you declare a class both abstract and final?

A) Compilation error

B) Class is abstract

C) Class is final

D) Allowed — no instances possible

Answer: A

48. In C++, virtual functions incur a cost due to:

A) vtable lookup at runtime

B) Extra memory per object (vptr)

C) Both A and B

D) Compile-time overhead only

Answer: C

49. The adapter pattern converts:

A) Interface of a class into another expected interface

B) Class into interface

C) Object into class

D) Inheritance into composition

Answer: A

50. In Java, reflection allows:

A) Inspecting and modifying classes/methods/fields at runtime

B) Only compile-time checks

C) Faster execution than normal calls

D) No security restrictions

Answer: A

=== TOPIC: Computer Networks, LEVEL: easy ===

1. What does the term "network" refer to in computer science?

A) A group of interconnected computers and devices

B) A single powerful computer

C) A software application

D) A storage device

Answer: A

2. Which of these is the most common type of network used in homes?

A) LAN (Local Area Network)

B) WAN (Wide Area Network)

C) MAN (Metropolitan Area Network)

D) PAN (Personal Area Network)

Answer: A

3. The Internet is an example of:

A) WAN

B) LAN

C) MAN

D) PAN

Answer: A

4. Which device connects multiple computers in a LAN?

A) Switch / Hub

B) Router

C) Modem

D) Repeater

Answer: A

5. What is the full form of IP in networking?

A) Internet Protocol

B) Internal Protocol

C) Interface Protocol

D) Information Protocol

Answer: A

6. Which protocol is used to access websites?

A) HTTP / HTTPS

B) FTP

C) SMTP

D) TCP

Answer: A

7. What does WWW stand for?

A) World Wide Web

B) Wide Web World

C) Web Wide World

D) World Web Wide

Answer: A

8. Which is the most commonly used web browser? (as of recent years)

A) Google Chrome

B) Internet Explorer

C) Netscape

D) Mosaic

Answer: A

9. The physical layout of a network is called:

A) Network topology

B) Network protocol

C) Network model

D) Network layer

Answer: A

10. Which topology connects all devices to a central hub?

A) Star topology

B) Bus topology

C) Ring topology

D) Mesh topology

Answer: A

11. How many layers are there in the OSI model?

A) 7

B) 5

C) 4

D) 6

Answer: A

12. Which is the topmost layer in the OSI model?

A) Application layer

B) Presentation layer

C) Session layer

D) Transport layer

Answer: A

13. Which OSI layer is responsible for routing?

A) Network layer

B) Data Link layer

C) Physical layer

D) Transport layer

Answer: A

14. Which layer handles error detection and correction in frames?

A) Data Link layer

B) Network layer

C) Physical layer

D) Session layer

Answer: A

15. The Physical layer deals with:

A) Transmission of raw bits over a medium

B) Routing packets

C) Establishing sessions

D) Data encryption

Answer: A

16. TCP/IP model has how many layers?

A) 4

B) 5

C) 7

D) 6

Answer: A

17. Which layer of TCP/IP model corresponds to OSI Application, Presentation, and Session layers combined?

A) Application layer

B) Transport layer

C) Internet layer

D) Network Access layer

Answer: A

18. IP address belongs to which layer?

A) Network layer (Internet layer in TCP/IP)

B) Transport layer

C) Data Link layer

D) Application layer

Answer: A

19. Which protocol is used to send emails?

A) SMTP

B) POP3

C) IMAP

D) HTTP

Answer: A

20. Which protocol is used to receive emails?

A) POP3 / IMAP

B) SMTP

C) FTP

D) DNS

Answer: A

21. DNS stands for:

A) Domain Name System

B) Data Name Service

C) Domain Network System

D) Dynamic Name Server

Answer: A

22. What is the default port number for HTTP?

A) 80

B) 443

C) 21

D) 25

Answer: A

23. What is the default port for HTTPS?

A) 443

B) 80

C) 22

D) 110

Answer: A

24. FTP stands for:

A) File Transfer Protocol

B) Fast Transfer Protocol

C) File Transmission Protocol

D) Folder Transfer Protocol

Answer: A

25. Which protocol is used for secure remote login?

A) SSH

B) Telnet

C) FTP

D) HTTP

Answer: A

26. How many bits are there in an IPv4 address?

A) 32 bits

B) 64 bits

C) 128 bits

D) 16 bits

Answer: A

27. How many bits are there in an IPv6 address?

A) 128 bits

B) 32 bits

C) 64 bits

D) 256 bits

Answer: A

28. Which device is used to connect two different networks?

A) Router

B) Switch

C) Hub

D) Bridge

Answer: A

29. Which device amplifies signals to extend network range?

A) Repeater

B) Switch

C) Router

D) Modem

Answer: A

30. MAC address is also called:

A) Physical address

B) Logical address

C) IP address

D) Port address

Answer: A

31. MAC address operates at which layer?

A) Data Link layer

B) Network layer

C) Physical layer

D) Transport layer

Answer: A

32. IP address operates at which layer?

A) Network layer

B) Data Link layer

C) Transport layer

D) Application layer

Answer: A

33. Bandwidth refers to:

A) Amount of data that can be transmitted per unit time

B) Physical size of cable

C) Number of devices

D) Speed of processor

Answer: A

34. Which transmission mode sends data in both directions but not simultaneously?

A) Half-duplex

B) Full-duplex

C) Simplex

D) Asynchronous

Answer: A

35. Which is an example of guided media?

A) Twisted pair cable

B) Radio waves

C) Infrared

D) Microwave

Answer: A

36. Which is an example of unguided media?

A) Wi-Fi (radio waves)

B) Coaxial cable

C) Optical fiber

D) Ethernet cable

Answer: A

37. Hub works at which layer?

A) Physical layer

B) Data Link layer

C) Network layer

D) Application layer

Answer: A

38. Switch works at which layer?

A) Data Link layer

B) Physical layer

C) Network layer

D) Transport layer

Answer: A

39. Router works at which layer?

A) Network layer

B) Data Link layer

C) Physical layer

D) Application layer

Answer: A

40. What is the purpose of a modem?

A) Modulate and demodulate signals (analog ↔ digital)

B) Route packets

C) Switch frames

D) Amplify signals

Answer: A

41. Which protocol is connection-oriented?

A) TCP

B) UDP

C) IP

D) ICMP

Answer: A

42. Which protocol is connectionless?

A) UDP

B) TCP

C) HTTP

D) FTP

Answer: A

43. What does ARP stand for?

A) Address Resolution Protocol

B) Automatic Routing Protocol

C) Address Relay Protocol

D) Application Resolution Protocol

Answer: A

44. Which protocol is used to test connectivity?

A) ICMP (Ping)

B) TCP

C) UDP

D) FTP

Answer: A

45. Firewall is used for:

A) Network security (filtering traffic)

B) Routing

C) Switching

D) Amplifying signals

Answer: A

46. Which is the most secure version of HTTP?

A) HTTPS

B) HTTP

C) FTP

D) Telnet

Answer: A

47. Bluetooth is an example of:

A) PAN (Personal Area Network)

B) LAN

C) WAN

D) MAN

Answer: A

48. Which topology has highest reliability but highest cost?

A) Mesh topology

B) Star topology

C) Bus topology

D) Ring topology

Answer: A

49. The process of converting domain name to IP address is called:

A) DNS resolution

B) ARP resolution

C) Routing

D) Switching

Answer: A

50. Which device is needed to connect a LAN to the Internet?

A) Router (or modem-router combo)

B) Switch only

C) Hub only

D) Repeater only

Answer: A

=== TOPIC: Computer Networks, LEVEL: medium ===

1. Which OSI layer is responsible for segmentation and reassembly of data?

A) Transport layer

B) Network layer

C) Data Link layer

D) Session layer

Answer: A

2. In the TCP/IP model, the Internet layer corresponds to which OSI layer?

A) Network layer

B) Data Link layer

C) Transport layer

D) Physical layer

Answer: A

3. Which layer provides process-to-process delivery using port numbers?

A) Transport layer

B) Network layer

C) Application layer

D) Session layer

Answer: A

4. The main difference between TCP and UDP is that TCP is:

A) Connection-oriented and reliable

B) Connectionless and unreliable

C) Faster than UDP

D) Used only for email

Answer: A

5. Which protocol operates at the Network layer?

A) IP

B) TCP

C) UDP

D) HTTP

Answer: A

6. How many usable host addresses are there in a /27 subnet?

A) 30

B) 32

C) 62

D) 126

Answer: A (2^5 - 2 = 30)

7. The classful IP address 172.16.10.5 belongs to which class?

A) Class B

B) Class A

C) Class C

D) Class D

Answer: A

8. What is the network address of 192.168.1.100 with subnet mask 255.255.255.240?

A) 192.168.1.96

B) 192.168.1.112

C) 192.168.1.100

D) 192.168.1.0

Answer: A

9. CIDR notation /24 represents subnet mask:

A) 255.255.255.0

B) 255.255.0.0

C) 255.0.0.0

D) 255.255.255.128

Answer: A

10. Private IP addresses are defined in which RFC?

A) RFC 1918

B) RFC 793

C) RFC 791

D) RFC 2460

Answer: A

11. Which protocol is used for reliable file transfer?

A) FTP

B) TFTP

C) SMTP

D) SNMP

Answer: A

12. The difference between POP3 and IMAP is that IMAP:

A) Allows messages to stay on server and sync across devices

B) Downloads and deletes from server

C) Is used only for sending mail

D) Uses port 25

Answer: A

13. DHCP stands for:

A) Dynamic Host Configuration Protocol

B) Domain Host Control Protocol

C) Dynamic Hardware Configuration Protocol

D) Data Host Configuration Protocol

Answer: A

14. Which protocol translates MAC address to IP address?

A) RARP

B) ARP

C) DNS

D) DHCP

Answer: A (Reverse ARP – though rarely used now)

15. SNMP is used for:

A) Network management and monitoring

B) File transfer

C) Email delivery

D) Web browsing

Answer: A

16. Which error detection method uses polynomial division?

A) CRC (Cyclic Redundancy Check)

B) Checksum

C) Parity bit

D) Hamming code

Answer: A

17. Stop-and-Wait ARQ is inefficient because:

A) Sender waits for ACK after every frame

B) It uses sliding window

C) It has no error control

D) It is full-duplex

Answer: A

18. Which protocol uses sliding window for flow control?

A) Go-Back-N and Selective Repeat

B) Stop-and-Wait only

C) Pure ALOHA

D) CSMA/CD

Answer: A

19. In CSMA/CD, what happens when a collision is detected?

A) Stations send jam signal and back off

B) Transmission continues

C) ACK is sent

D) Frame is retransmitted immediately

Answer: A

20. Token Ring uses which access method?

A) Token passing

B) CSMA/CA

C) CSMA/CD

D) FDMA

Answer: A

21. A Layer 2 switch forwards frames based on:

A) MAC address

B) IP address

C) Port number

D) Protocol type

Answer: A

22. A router makes forwarding decisions based on:

A) Destination IP address

B) Source MAC address

C) Port number

D) VLAN ID

Answer: A

23. Which switching technique stores the entire frame before forwarding?

A) Store-and-forward

B) Cut-through

C) Fragment-free

D) Fast-forward

Answer: A

24. VLANs are used to:

A) Segment broadcast domains logically

B) Increase collision domains

C) Route packets

D) Perform NAT

Answer: A

25. NAT stands for:

A) Network Address Translation

B) Network Access Translation

C) Node Address Translation

D) Network Authentication Technique

Answer: A

26. Which Wi-Fi standard operates at 5 GHz and provides higher speed?

A) 802.11ac / 802.11ax

B) 802.11b

C) 802.11g

D) 802.11a

Answer: A (802.11ac widely known as 5 GHz high-speed)

27. CSMA/CA is used in:

A) Wireless LAN (802.11)

B) Ethernet (802.3)

C) Token Ring

D) Bluetooth

Answer: A

28. Firewall operates primarily at:

A) Network layer (packet filtering) and above

B) Physical layer only

C) Data Link layer only

D) Application layer only

Answer: A

29. Which protocol provides secure version of Telnet?

A) SSH

B) FTP

C) HTTP

D) SMTP

Answer: A

30. WPA3 is an improvement over WPA2 mainly in:

A) Stronger encryption and protection against brute-force attacks

B) Speed

C) Range

D) Compatibility

Answer: A

31. The maximum payload size in Ethernet frame is:

A) 1500 bytes (MTU)

B) 1518 bytes

C) 64 bytes

D) 9000 bytes (jumbo)

Answer: A

32. Which field in TCP header ensures reliability?

A) Sequence number and Acknowledgement number

B) Checksum only

C) Window size

D) Urgent pointer

Answer: A

33. Three-way handshake in TCP is used for:

A) Connection establishment

B) Connection termination

C) Error detection

D) Flow control

Answer: A

34. Congestion control in TCP uses:

A) Slow start, congestion avoidance, fast retransmit/recovery

B) Only sliding window

C) Stop-and-wait

D) Token bucket

Answer: A

35. Which protocol is used for loop prevention in switched networks?

A) STP (Spanning Tree Protocol)

B) RIP

C) OSPF

D) BGP

Answer: A

36. Distance Vector routing protocol example:

A) RIP

B) OSPF

C) BGP

D) IS-IS

Answer: A

37. Link State routing uses:

A) Dijkstra’s algorithm

B) Bellman-Ford algorithm

C) Flooding only

D) Hop count only

Answer: A

38. Which is a classless routing protocol?

A) OSPF, RIP v2, EIGRP

B) RIP v1

C) IGRP

D) All classful

Answer: A

39. ICMP is used for:

A) Error reporting and diagnostics (ping, traceroute)

B) File transfer

C) Email

D) Web browsing

Answer: A

40. The purpose of subnet mask is to:

A) Separate network and host portions of IP address

B) Encrypt data

C) Assign MAC addresses

D) Perform flow control

Answer: A

41. Which protocol assigns IP addresses automatically?

A) DHCP

B) ARP

C) DNS

D) SNMP

Answer: A

42. DNS uses which transport protocol by default for queries?

A) UDP (port 53)

B) TCP only

C) ICMP

D) IP directly

Answer: A

43. Which is a connectionless protocol?

A) UDP

B) TCP

C) SCTP

D) HTTP/2

Answer: A

44. The main advantage of circuit switching is:

A) Guaranteed bandwidth and no delay variation

B) Efficient for bursty traffic

C) No setup time

D) Shared bandwidth

Answer: A

45. Packet switching is more efficient for:

A) Bursty and variable traffic

B) Constant bit rate voice

C) Real-time video without jitter

D) Fixed-size packets only

Answer: A

46. Which layer handles multiplexing using port numbers?

A) Transport layer

B) Network layer

C) Data Link layer

D) Physical layer

Answer: A

47. Hamming code is used for:

A) Single-bit error correction

B) Single-bit error detection only

C) Burst error detection

D) CRC calculation

Answer: A

48. In Manchester encoding, bit rate is:

A) Half the baud rate

B) Equal to baud rate

C) Twice the baud rate

D) Four times baud rate

Answer: B (transition per bit → baud rate = bit rate)

49. Which is the correct order of encapsulation in TCP/IP?

A) Data → Segment → Packet → Frame → Bits

B) Data → Packet → Segment → Frame → Bits

C) Bits → Frame → Packet → Segment → Data

D) Frame → Packet → Segment → Data → Bits

Answer: A

50. The main function of ARP is:

A) Resolve IP address to MAC address

B) Resolve domain name to IP

C) Assign IP addresses

D) Route packets

Answer: A

=== TOPIC: Computer Networks, LEVEL: hard ===

1. In TCP Tahoe, when timeout occurs:

A) cwnd is set to 1 MSS, ssthresh = cwnd/2

B) cwnd is set to 1 MSS, ssthresh = flight size/2

C) Fast recovery is entered

D) cwnd remains unchanged

Answer: A

2. In TCP Reno, during fast recovery:

A) cwnd is increased by 1 MSS for each duplicate ACK

B) cwnd is halved only on timeout

C) ssthresh is not updated

D) Three duplicate ACKs trigger slow start

Answer: A

3. The main difference between TCP NewReno and Reno is:

A) NewReno handles multiple losses in one window without exiting fast recovery early

B) NewReno uses selective acknowledgments

C) NewReno never halves cwnd

D) NewReno uses Vegas delay-based mechanism

Answer: A

4. TCP Cubic is primarily designed to:

A) Achieve better fairness and utilize high bandwidth-delay product links

B) Minimize RTT estimation error

C) Replace slow start completely

D) Use only additive increase

Answer: A

5. In TCP Vegas, congestion is detected primarily by:

A) Increase in RTT (expected vs actual throughput)

B) Packet loss only

C) Triple duplicate ACKs

D) Three-way handshake delay

Answer: A

6. In link-state routing, the Dijkstra algorithm complexity is:

A) O((V+E) log V) with binary heap

B) $O(V^2)$ with simple implementation

C) Both A and B possible depending on implementation

D) O(E log V) always

Answer: C

7. BGP uses which path attribute to prevent loops?

A) AS_PATH

B) NEXT_HOP

C) LOCAL_PREF

D) MED

Answer: A

8. In OSPF, which LSA type describes external routes?

A) Type 5 (AS-external-LSA)

B) Type 1 (Router-LSA)

C) Type 2 (Network-LSA)

D) Type 3 (Summary-LSA)

Answer: A

9. The count-to-infinity problem is most severe in:

A) Distance Vector routing without split horizon + poison reverse

B) Link State routing

C) Path Vector routing

D) Hybrid routing

Answer: A

10. Which BGP attribute is used for intra-AS path selection preference?

A) LOCAL_PREF

B) AS_PATH length

C) MED

D) Weight (Cisco proprietary)

Answer: A

11. In IPv6, the flow label field is used to:

A) Identify packets belonging to the same flow for QoS treatment

B) Replace the traffic class field

C) Carry hop-by-hop options

D) Perform fragmentation

Answer: A

12. Which IPv6 address type is used for one-to-nearest communication?

A) Anycast

B) Multicast

C) Unicast

D) Link-local

Answer: A

13. The IPv6 header does NOT include:

A) Checksum field

B) Fragmentation fields

C) Time to Live (Hop Limit)

D) Source and Destination addresses

Answer: A

14. In CIDR, the longest prefix match is performed because:

A) It selects the most specific route

B) It reduces routing table size

C) It prevents supernetting

D) It enforces classful boundaries

Answer: A

15. The purpose of IPv6 Neighbor Discovery Protocol (NDP) includes:

A) Router discovery, address autoconfiguration, neighbor unreachability detection

B) Replacing ARP completely

C) Both A and B

D) Only duplicate address detection

Answer: C

16. In 802.11 DCF, the backoff timer is frozen when:

A) The medium is sensed busy

B) NAV is greater than zero

C) Both A and B

D) ACK timeout occurs

Answer: C

17. The hidden terminal problem is best mitigated by:

A) RTS/CTS handshake

B) CSMA/CD

C) Token passing

D) FDMA

Answer: A

18. In 802.11n/ac/ax, MIMO primarily increases:

A) Spatial multiplexing gain (multiple streams)

B) Only range

C) Only interference rejection

D) Frequency reuse

Answer: A

19. OFDMA in 802.11ax allows:

A) Multiple users to transmit simultaneously in different subcarriers

B) Single user only per channel

C) Backward compatibility removal

D) Only uplink MU-MIMO

Answer: A

20. Beamforming in Wi-Fi improves:

A) SNR at receiver by directing energy

B) Channel bandwidth

C) MAC layer efficiency only

D) Power consumption always

Answer: A

21. RED (Random Early Detection) drops packets:

A) Probabilistically before queue is full to signal congestion early

B) Only when queue is full

C) Based on TCP sequence numbers

D) Using tail drop always

Answer: A

22. In DiffServ, the DSCP field is used to:

A) Mark packets for different per-hop behaviors (PHB)

B) Replace IP precedence completely

C) Carry flow labels

D) Perform classification only at edge

Answer: A

23. The leaky bucket algorithm enforces:

A) Long-term average rate with burst tolerance

B) Strict peak rate

C) No burst at all

D) Variable delay

Answer: A

24. In token bucket, if token arrival rate is r and bucket depth is b, maximum burst size is:

A) b + r×t (where t is time)

B) b only

C) r only

D) Infinite if tokens accumulate

Answer: A

25. Little's Law states that:

A) Average number of items in system = arrival rate × average time in system

B) Throughput = capacity × utilization

C) Delay = bandwidth × packet size

D) Queue length = arrival rate²

Answer: A

26. IPsec transport mode protects:

A) Only payload (upper-layer data)

B) Entire IP packet

C) Only IP header

D) Only TCP header

Answer: A

27. In IPsec tunnel mode, the original IP header is:

A) Encrypted and encapsulated inside a new IP header

B) Left unencrypted

C) Removed completely

D) Used for routing only

Answer: A

28. Which IKE mode is used to establish the IKE SA?

A) Main Mode or Aggressive Mode

B) Quick Mode only

C) Phase 2 only

D) Tunnel mode

Answer: A

29. The purpose of AH (Authentication Header) in IPsec is:

A) Provide authentication and integrity but not confidentiality

B) Provide encryption only

C) Replace ESP completely

D) Perform key exchange

Answer: A

30. In SSL/TLS, the master secret is computed using:

A) Pre-master secret + client random + server random

B) Only pre-master secret

C) Session ID only

D) Public key only

Answer: A

31. In Selective Repeat ARQ, the sender window size must be:

A) ≤ 2^(m-1) where m = sequence number bits

B) ≤ 2^m

C) Exactly 1

D) Unlimited

Answer: A

32. The bandwidth-delay product represents:

A) Bits that can be in flight on the link

B) Maximum throughput

C) Queue size

D) Retransmission timeout

Answer: A

33. In BGP route reflection, the main purpose is:

A) Reduce full-mesh iBGP peering requirement

B) Replace eBGP

C) Perform route aggregation

D) Enforce MED

Answer: A

34. MPLS label stacking is used for:

A) Traffic engineering and VPNs (VPNv4, VPLS, etc.)

B) Replacing IP routing

C) Layer 2 switching only

D) QoS marking only

Answer: A

35. ECN (Explicit Congestion Notification) marks packets instead of dropping them when:

A) Router queue is congested (using ECT and CE bits)

B) Link is down

C) MTU mismatch occurs

D) Fragmentation is needed

Answer: A

36. In QUIC (HTTP/3), connection migration is possible because:

A) Connection ID is used instead of 4-tuple

B) It uses TCP underneath

C) It is connectionless

D) It only supports IPv4

Answer: A

37. The main advantage of Segment Routing (SR) over RSVP-TE is:

A) No per-path signaling/state in core routers

B) Better QoS

C) Lower latency always

D) Mandatory encryption

Answer: A

38. In 6LoWPAN, header compression is needed because:

A) IPv6 header is too large for low-power wireless frames

B) It replaces IPv6 completely

C) It uses only UDP

D) It eliminates fragmentation

Answer: A

39. The purpose of PCP (Port Control Protocol) is:

A) Allow hosts behind NAT to request port mappings dynamically

B) Replace UPnP

C) Perform NAT traversal for IPv4 only

D) Both A and B

Answer: D

40. In SDN, the southbound interface is typically:

A) OpenFlow

B) BGP-LS

C) NETCONF

D) RESTCONF

Answer: A

41. VXLAN uses which protocol for encapsulation?

A) UDP port 4789

B) TCP port 4789

C) GRE

D) IP-in-IP

Answer: A

42. Geneve is preferred over VXLAN in some cases because:

A) It has flexible metadata (TLV format)

B) It uses TCP

C) It has smaller header

D) It supports only IPv4

Answer: A

43. In CoAP (Constrained Application Protocol), reliability is provided by:

A) Confirmable messages (similar to ACK)

B) Always using TCP

C) No reliability

D) Only DTLS

Answer: A

44. The main drawback of proxy ARP is:

A) Increases ARP traffic and can cause security issues

B) Reduces broadcast domain

C) Improves routing table size

D) Eliminates need for default gateway

Answer: A

45. In OSPFv3, which field replaces the Authentication field of OSPFv2?

A) IPsec AH/ESP is used instead

B) Authentication type field remains

C) MD5 is mandatory

D) No authentication support

Answer: A

46. The purpose of BFD (Bidirectional Forwarding Detection) is:

A) Provide sub-second failure detection for routing protocols

B) Replace hello packets completely

C) Perform QoS marking

D) Handle fragmentation

Answer: A

47. In TCP, the urgent pointer is used when:

A) URG flag is set to indicate out-of-band data

B) FIN flag is set

C) RST flag is set

D) PSH flag is set

Answer: A

48. Which field in IPv4 header is modified by every router?

A) TTL (Time to Live)

B) Identification

C) Fragment offset

D) Protocol

Answer: A

49. In multicast, PIM-SM uses:

A) Rendezvous Point (RP) for shared tree

B) Source-specific tree only

C) Dense mode flooding

D) No RP required

Answer: A

50. The main goal of Network Function Virtualization (NFV) is:

A) Replace dedicated hardware appliances with virtualized software functions running on commodity servers

B) Increase physical cabling

C) Eliminate SDN

D) Reduce virtualization overhead

Answer: A