Ph. D. (CSE) Entrance Examination 2026

Time : 2 Hours

Maximum Marks : 100

Do not open this Test Booklet until you are asked to do so.

Immediately fill in the particulars on this page of the Question Booklet and the Answer Sheet with Blue/Black Ball Point Pen. Use of pencil is strictly prohibited.

Name of the candidate (In Capital Letters) : _____

Roll Number (In Figure) : | | | | | | | | | | |

(In Words) : _____

Name of Examination Centre (in Capital Letters) : _____

Candidate's Signature : _____ Invigilator's Signature _____

Important Instructions :

This booklet contains 100 objective type questions. First 50 questions of Research Methodology and Second 50 questions of Subject Specific. Each having four options a, b, c, d.

1. Candidates are not allowed to carry textual material printed or written, bits of papers, pages, mobile phone, electronic device or any other material except the Admit Card inside the Examination Hall/Room.
2. The candidates should fill in the required particulars on the Test Booklet and Answer Sheet with Blue/ Black Ball Point Pen.
3. The candidate should not write their Roll Number anywhere else (except in the specified space) on the Test Booklet/Answer Sheet.
4. Out of the four options given for each question, the candidate must mark one correct option as an answer only.
5. There is no negative marking for any wrong answer.
6. Handle the Test Booklet and Answer Sheet with care, as under no circumstances (except for discrepancy in the Test Booklet Code and Answer Sheet Code), will another set be provided.
7. The candidates are not allowed to do any rough work or writing work on the Answer Sheet. All calculations/writing work are to be done in the space available in the Test Booklet itself.
8. Each candidate must show on demand her Admit Card to the Invigilator.
9. No candidate, without special permission of the Superintendent or Invigilator, should leave her seat.
10. The candidate should not leave the Examination Hall without handing over their Answer Sheet and Test Booklet to the invigilator on the duty and signing the Attendance Sheet.
11. No part of the Test Booklet and Answer Sheet shall be detached under circumstances.

NOTE : THIS BOOKLET SHALL BE RETAINED FOR SIX MONTH ONLY.

(Research Methodology)

1. A researcher has 12,000 households and wants a systematic sample of 600 households. The sampling interval should be:

A. 10
B. 15
C. 20
D. 25

2. Spearman's rank correlation is particularly appropriate when:

A. Variables are ranked/ordinal or assumptions for Pearson correlation are unsuitable
B. Both variables must be nominal
C. The researcher is comparing two means
D. The dependent variable is necessarily binary

3. The Kruskal-Wallis test is a non-parametric alternative to:

A. Independent t-test
B. Paired t-test
C. One-way ANOVA
D. Pearson correlation

4. The Mann-Whitney U test is generally used as a non-parametric alternative to:

A. Paired t-test
B. Independent-samples t-test
C. One-way ANOVA
D. Pearson correlation

5. A complete list of all elements from which a sample is actually drawn is called:

A. Population parameter
B. Research universe
C. Sample statistic
D. Sampling frame

6. Which of the following best distinguishes basic research from applied research?

A. Basic research is always quantitative, whereas applied research is qualitative
B. Basic research primarily develops knowledge/theory, whereas applied research addresses practical problems
C. Basic research uses primary data, whereas applied research uses secondary data
D. Basic research does not require hypotheses

7. A researcher obtains a p-value of 0.03 and uses a 5% significance level. What is the appropriate decision?

A. Reject H0 because $0.03 < 0.05$
B. Accept H0 because $0.03 < 0.05$
C. Reject H1 because $0.03 > 0.01$
D. No decision can be made from the p-value

8. Suppose training increases employee motivation, which subsequently increases productivity. Motivation is best described as:

A. Control variable
B. Intervening variable
C. Extraneous variable
D. Sampling-frame variable

9. A researcher changes or selectively manipulates recorded data so that the results support the hypothesis. This is:

A. Fabrication
B. Falsification
C. Peer review
D. Triangulation

10. A sample mean is 80, population standard deviation is 20 and sample size is 100. Using z=1.96, the approximate 95% confidence interval is:

A. 76.08 to 83.92
B. 78.04 to 81.96
C. 60.00 to 100.00
D. 79.60 to 80.40

11. The principal purpose of a pilot study is to:

A. Produce the final findings
B. Test and refine research procedures and instruments before the main study
C. Replace the sampling process
D. Guarantee external validity

12. Which test is most appropriate for comparing the means of two independent groups when the assumptions of a parametric test are reasonably satisfied?

A. Independent-samples t-test
B. Chi-square test
C. Wilcoxon signed-rank test
D. Kruskal-Wallis test

13. A theoretical framework primarily:

A. Specifies the computer software to be used
B. Replaces the research design
C. Determines the sample size automatically
D. Connects the research problem with relevant theories and concepts

14. A chi-square goodness-of-fit test has four categories. The degrees of freedom are:

A. 2
B. 3
C. 4
D. 5

15. A researcher invents observations that were never actually collected and enters them into the dataset. This is:

A. Plagiarism

B. Fabrication
C. Falsification
D. Self-citation

16. A population contains four strata with sizes 100, 200, 300 and 400. If a proportional sample of 100 is required, the number selected from the third stratum should be:

A. 20
B. 25
C. 30
D. 40

17. A survey records the following frequencies for four response categories: 20, 35, 25 and 20. What is the cumulative frequency after the third category?

A. 55
B. 60
C. 80
D. 100

18. A questionnaire contains 40 items. A researcher removes 8 poorly performing items. What percentage of the original items has been removed?

A. 15%
B. 20%
C. 25%
D. 32%

19. A one-way ANOVA has three groups and 45 total observations. The within-groups degrees of freedom are:

A. 2
B. 3
C. 42
D. 44

20. The primary purpose of research design is to:

A. Determine only the sample size
B. Provide a logical framework for answering the research questions
C. Eliminate the need for data analysis
D. Ensure that every hypothesis is accepted

21. Which design is strongest for establishing a causal relationship between an independent and dependent variable?

A. Descriptive design
B. Historical design
C. Cross-sectional survey
D. Experimental design

22. A sample has a mean of 50 and standard deviation of 10. If the sample size is 100, the standard error of the mean is:

A. 0.1
B. 1
C. 10

D. 100

23. A researcher observes that several studies have examined employee satisfaction but very few have investigated whether satisfaction differs between remote and hybrid employees. This observation primarily helps the researcher identify:

A. Sampling error
B. Type-I error
C. Measurement scale
D. Research gap

24. A one-way ANOVA compares four groups, each containing 10 observations. The total number of observations is 40. The between-groups degrees of freedom are:

A. 3
B. 4
C. 36
D. 39

25. In a regression equation Y=20+3X, an increase of 4 units in X is associated with a predicted increase in Y of:

A. 4
B. 7
C. 12
D. 80

26. Validity primarily concerns:

A. Consistency only
B. Whether an instrument measures what it is intended to measure
C. Sample size
D. Response rate

27. A researcher studies the reasons for unusually high employee turnover in one organisation and recommends immediate changes in its HR policies. This research is most appropriately classified as:

A. Fundamental research
B. Conceptual research
C. Historical research
D. Action research

28. Which source is generally considered a scholarly source?

A. Anonymous social-media post
B. Peer-reviewed journal article
C. Commercial advertisement
D. Unverified blog post

29. Which of the following best represents a research question?

A. Employee motivation is positively related to productivity.
B. To determine whether training improves productivity.
C. Does training intensity influence employee productivity?
D. Training intensity is the independent variable.

30. Snowball sampling is particularly useful when:

A. A complete sampling frame exists
B. The population is hidden or difficult to reach
C. Equal probability selection is mandatory
D. The population is extremely homogeneous

31. A researcher decides in advance to interview 50 male and 50 female consumers but selects participants through convenience. This is:

A. Stratified random sampling
B. Quota sampling
C. Cluster sampling
D. Systematic sampling

32. Which Boolean search string would most effectively retrieve literature concerning both employee engagement and remote work while allowing either term 'employee engagement' or 'work engagement'?

A. employee engagement OR remote work
B. employee engagement AND remote work OR work engagement
C. (employee engagement OR work engagement) AND remote work
D. employee engagement NOT remote work

33. The major conceptual difference between stratified and cluster sampling is that:

A. Stratified sampling is always non-probability sampling
B. Strata are usually internally similar, while clusters are ideally miniature representations of the population
C. Clusters are always smaller than strata
D. Stratified sampling never uses random selection

34. Cronbach's alpha is primarily associated with:

A. Sampling error
B. Internal consistency reliability
C. External validity
D. Normality testing

35. A normal distribution has mean 100 and standard deviation 15. What is the z-score for an observation of 130?

A. 1
B. 1.5
C. 2
D. 2.5

36. A researcher uses Generative AI to help draft a literature review. Which practice is most consistent with responsible research?

A. Submit AI-generated text without verification
B. Assume all AI-generated references are genuine
C. Verify sources, maintain transparency about appropriate AI use, protect confidential data and retain human responsibility for the scholarly work
D. List the AI tool as the sole author of the research paper

37. The main purpose of a research proposal is to:

A. Present only the final statistical results
B. Provide a systematic plan and justification for the proposed research
C. Replace the literature review
D. Guarantee that the hypothesis will be supported

38. In a study, 60 respondents belong to Group A, 90 to Group B and 150 to Group C. What percentage of the sample belongs to Group B?

A. 20%
B. 25%
C. 30%
D. 37.5%

39. A researcher divides employees into departments and randomly selects employees from each department. This is:

A. Cluster sampling
B. Stratified sampling
C. Snowball sampling
D. Convenience sampling

40. If the correlation coefficient between advertising expenditure and sales is r=0.80, the coefficient of determination is:

A. 0.16
B. 0.40
C. 0.64
D. 0.80

41. A questionnaire appears, on superficial inspection, to measure employee satisfaction. This is best described as:

A. Face validity
B. Criterion validity
C. Predictive validity
D. Internal consistency

42. A researcher receives 360 usable responses from 450 distributed questionnaires. The response rate is:

A. 70%
B. 75%
C. 80%
D. 85%

43. A newly developed aptitude test is compared with an established test measuring the same construct. This is evidence most closely related to:

A. Construct validity
B. Face validity
C. Sampling validity
D. Internal validity

44. Increasing sample size generally reduces:

A. Non-sampling error automatically
B. Sampling error
C. Response bias automatically
D. Measurement error automatically

45. For the data 5, 8, 12, 17 and 20, the range is:

A. 12
B. 15
C. 17
D. 20

46. Which question is most clearly open-ended?

A. Are you satisfied? Yes/No
B. Rate satisfaction from 1 to 5
C. What factors influenced your decision to leave the organisation?
D. Do you agree? Strongly agree/Agree/Neutral/Disagree/Strongly disagree

47. Which property distinguishes a ratio scale from an interval scale?

A. Ranking
B. Equal intervals
C. Meaningful absolute zero
D. Categorisation

48. If r= -0.70, the relationship between two variables is:

A. Strong positive
B. Moderate/strong negative
C. Perfect negative
D. No relationship

49. Which of the following is an example of primary data?

A. Data obtained from a published government report
B. Data collected directly by the researcher through interviews
C. Data obtained from an existing journal article
D. Data downloaded from an archival database

50. A researcher receives 270 completed questionnaires out of 360 distributed. If 30 questionnaires are rejected because of missing data, what percentage of distributed questionnaires becomes usable?

A. 60%
B. 66.67%
C. 75%
D. 83.33%

51.	Consider the statement: *Every student in the class has passed at least one subject.* Which of the following correctly represents this statement? Let *Student*(*x*) mean "*x* is a student", *Subject*(*y*) mean "*y* is a subject", and *Passed*(*x*,*y*) mean "*x* passed *y*". A. $\forall x \forall y[Student(x) \rightarrow Passed(x,y)]$ B. $\exists x \forall y[\text{Student}(x) \wedge \text{Passed}(x,y)]$ C. $\forall x[\text{Student}(x) \rightarrow \exists y(\text{Subject}(y) \wedge \text{Passed}(x,y))]$ D. $\exists x \exists y[\text{Student}(x) \wedge \text{Subject}(y) \wedge \neg \text{Passed}(x,y)]$
52.	Let $G = (V, E)$ be a connected undirected graph with n vertices. Suppose that G contains exactly $n - 1$ edges. Which conclusion follows necessarily? A. There is exactly one simple path between every pair of vertices. B. Every pair of vertices is connected by exactly one edge. C. G contains exactly one cycle. D. Every vertex has degree at least two.
53.	Consider the matrix: $A = \begin{bmatrix} 2 & 1 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 3 \end{bmatrix}$ Which of the following statements is **TRUE**? A. The matrix has 3 linearly independent eigenvectors B. The algebraic multiplicity of eigenvalue $\lambda=2$ equals its geometric multiplicity C. The matrix is diagonalizable D. The geometric multiplicity of eigenvalue $\lambda=2$ is 1
54.	A medical test for a rare disease (prevalence 1%) has 99% sensitivity and 95% specificity. If a randomly selected person tests positive, what is the probability they actually have the disease? A. 99% B. 95% C. Approximately 17% D. Approximately 50%
55.	The lifetime of a component follows an exponential distribution with mean 100 hours. What is the probability that a component that has already survived 50 hours will survive at least 100 more hours? A. e^{-1} B. $e^{-0.5}$ C. $e^{-1.5}$ D. $1 - e^{-1}$

56.	For the function: $$F(A,B,C,D) = \sum m\,(1,3,7,11,15) + d(0,2,5)$$ How many **essential prime implicants** exist in the minimal SOP realization? A. 2 B. 1 C. 3 D. 4
57.	A combinational circuit implements: $$F = AB + A'C$$ During testing, a static-1 hazard is observed when $B = C = 1$ and input A transitions. Which additional consensus term must be included to obtain a hazard-free two-level SOP implementation? A. Add term BC to the expression B. Add term $AB + AC$ to the expression C. Replace with $F = (A + C)(A' + B)$ D. Both A and C
58.	A 4-bit 2's complement adder adds: $A = 0110$ and $B = 0101$. Which statement is **TRUE** regarding overflow? A. No overflow; sum = 1011 (correct) B. Overflow occurs; sum is incorrect C. No overflow; sum = 1011 represents -5 D. Overflow occurs because carry-out = 1
59.	A synchronous mod-6 counter is designed using JK flip-flops with the counting sequence: $000 \rightarrow 001 \rightarrow 010 \rightarrow 011 \rightarrow 100 \rightarrow 101 \rightarrow 000$. If the counter enters an unused state 110 due to noise, what is the next state assuming standard JK excitation equations derived from the valid sequence? A. 111 B. 000 C. 101 D. 010
60.	A completely specified sequential machine has 8 states. After applying the partitioning method for state minimization, the final partition is: $$P = \{(S_0,S_3,S_7),(S_1,S_5),(S_2,S_4,S_6)\}$$ What is the minimum number of flip-flops needed to implement the reduced machine? A. 1 B. 2 C. 3

	D. 4
61.	The decimal number -12.625 is represented in IEEE 754 single-precision format. What is the hexadecimal representation of this 32-bit pattern? A. C14A0000 B. C1490000 C. 414A0000 D. C15A0000
62.	A processor uses multiple addressing modes. Given: • Base Register (BR) = 2000 • Index Register (XR) = 100 • Program Counter (PC) = 3000 • Instruction displacement = 50 For an instruction with base-plus-index-plus-displacement addressing mode, what is the effective address? A. 2100 B. 2150 C. 3150 D. 2050
63.	A processor has four interrupt sources with the following priorities: $I_1 > I_2 > I_3 > I_4$. The processor is currently executing the handler for I_3. While this handler is executing, I_2 and I_4 become pending. If nested interrupts are enabled and an interrupt can preempt the current handler only when it has higher priority, which interrupt will be serviced next? A. I_2 B. I_3 C. I_4 D. Both I_2 and I_4 simultaneously
64.	A processor designer must choose between hardwired and microprogrammed control. Which scenario MOST strongly favors a hardwired control unit? A. A CISC processor supporting complex instructions and numerous addressing modes B. A RISC processor with simple, fixed-length instructions and a small instruction set C. A processor whose instruction set is expected to undergo frequent modifications D. A processor requiring flexible implementation of complex multi-cycle instructions
65.	A 5-stage pipeline has: • 20% branch instructions

- Branch target known at EX stage (stage 3)
- Dynamic branch prediction with 90% accuracy
- Mispredicted branches cause 2-cycle penalty

What is the average CPI (Cycles Per Instruction)?

A. 1.04
B. 1.08
C. 1.12
D. 1.20

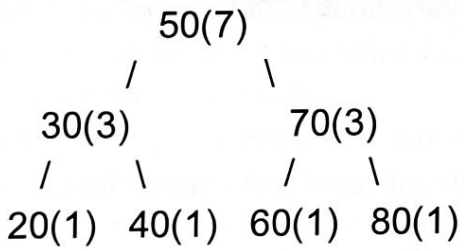
66. Consider the following C declarations:

```
const volatile int *ptr1;
volatile const int *ptr2;
int const volatile *ptr3;
```

Which statement is TRUE?

A. All three declarations are identical
B. ptr1 and ptr2 are identical, but different from ptr3
C. All three declarations are different
D. ptr1 and ptr3 are identical, but different from ptr2

67. A BST is augmented with subtree size at each node.
Given the tree (numbers in parentheses are subtree sizes):



What is the rank of key 40 (1-indexed position in sorted order)?

A. 2
B. 5
C. 4
D. 3

68. A binary min-heap orders elements using the following custom comparator:

```
bool compare(int a, int b) {
   return (a % 10) < (b % 10);  // Compare by last digit
}
```

After inserting: **23, 45, 67, 89, 12, 34, 56**
What is the **root** of the heap?

A. 34

	B. 23 C. 12 D. 56
69.	A weighted graph has non-negative edge weights. Starting from source vertex S, consider only edges whose weight is ≤ 5. Among the non-source vertices reachable from S using only these edges, we want the vertex having the minimum number of edges from S. Which algorithm is MOST appropriate? A. Dijkstra's algorithm on the filtered graph B. BFS on the filtered graph C. DFS on the filtered graph D. Floyd-Warshall algorithm on the filtered graph
70.	Let $L = \{w \in \{0,1\}^* \mid w \text{ contains an even number of 1s and ends with } 01\}.$ What is the minimum number of states required by a complete DFA recognizing L? A. 3 B. 4 C. 6 D. 8
71.	Consider $L = \{a^i, b^j, c^k, \mid i = j \text{ or } j = k \; ijk \geq 0\}.$ Which observation is most useful for determining whether L is context-free? **A.** It is the union of the two CFLs $\{a^n b^n c^k\}$and $\{a^i b^n c^n\}$ **B.** It requires simultaneously enforcing $i = j = k$ **C.** It contains $a^n b^n c^n$, so it cannot be context-free **D.** The presence of three symbol types automatically makes it non-context-free
72.	Suppose an undecidable language A is reducible to a language B by a computable mapping: If $A \leq_m B$ and A is undecidable, what follows? **A.** B must be decidable **B.** B must be finite **C.** If B were decidable, then A would also be decidable; hence B must be undecidable **D.** A and B must be identical
73.	Suppose a decision problem about Turing machines is known to be undecidable for arbitrary machines. A researcher restricts the input machines to a particular syntactic subclass. Which conclusion is valid? A. The restricted problem must remain undecidable B. The restricted problem must become regular

	C. Undecidability for the unrestricted problem alone does not establish undecidability for the restricted subclass D. Every restriction preserves computational hardness
74.	A language L is known to satisfy: 1. L is recursively enumerable. 2. $\bar{L}$ is recursively enumerable. Which statement is necessarily true? A. L is regular B. L is context-free C. L is finite D. L is recursive
75.	Suppose $$T(n) = 2T(n/2) + \frac{n}{\log n}.$$ Which asymptotic bound is correct? A. $\Theta(n)$ B. $\Theta(n \log\log n)$ C. $\Theta(n \log n)$ D. $\Theta(n^2)$
76.	A candidate designs a DP algorithm in which the state is only the current position i. However, the future feasible choices also depend on how much of a limited resource has already been consumed. What is the principal correctness concern? **A.** Two situations with the same $i$but different resource usage may have different optimal continuations, so the state does not contain sufficient information. B. The algorithm must necessarily become exponential. C. Dynamic programming cannot represent resource constraints. D. The recurrence automatically becomes greedy.
77.	Every edge weight in a connected undirected graph is increased by the same positive constant c. Which statement is necessarily true? A. Neither MSTs nor shortest paths can be determined after the transformation. B. Every shortest path remains a shortest path, but MSTs may change. C. Both MSTs and shortest paths must change. D Every MST remains an MST, but shortest paths between vertices need not remain unchanged
78.	Consider a connected weighted undirected graph with **nonnegative** edge weights. The

	requirement is to find shortest paths from one source to every vertex. Which statement correctly distinguishes the relevant algorithms? A. Prim's algorithm and Dijkstra's algorithm are interchangeable because both repeatedly select a minimum-weight edge. B. Dijkstra's algorithm selects vertices based on tentative source distance, whereas Prim's algorithm selects edges/vertices based on minimum connection cost for an MST. C. Prim's algorithm produces shortest paths whenever all edge weights are nonnegative. D. Dijkstra's algorithm always produces an MST.
79.	Bellman-Ford is run from source s. After $\|V\| - 1$ complete relaxation passes, one additional pass finds an edge (uv)satisfying $$d[v] > d[u] + w(uv),$$ where u is reachable from s. What does this imply? A. There is a reachable negative-weight cycle. B. There is necessarily a positive-weight cycle. C. The graph is disconnected. D. The shortest path contains exactly $\|V\| - 1$ edges.
80.	Consider: 1. a = 10 2. b = a + c 3. if (p) 4. a = 20 5. d = a + c 6. e = b + d Assume p is unknown at compile time and there are no definitions of c between these statements. Which statement is correct? A. a+c at statement 5 can always be replaced by the value computed at statement 2. B. b can be constant-propagated to a numeric constant. C. The expression a+c at statement 5 cannot be replaced by the value from statement 2 because a may have been redefined. D. Statement 4 is dead because a already had a definition.
81.	Consider a production $$A \to BC$$ with semantic rules $$B.x = A.x + 1$$ $$C.x = B.x + A.y.$$

	What must be true for these attributes to be evaluated in a valid dependency order? A. $C.x$ must be evaluated before $B.x$. B. $B.x$ must be evaluated before $C.x$. C. $A.x$ must be synthesized from $C.x$. D. The attributes cannot be evaluated because both are inherited.
82.	For the grammar $$S \rightarrow if\ E\ then\ S\ else\ S | if\ E\ then\ S | a$$ which transformation addresses the common-prefix problem but does not by itself resolve the dangling-else ambiguity? A. $S \rightarrow if\ E\ then\ S\ S' | a$ B. $S \rightarrow if\ E\ then\ S\ (else\ S)? | a$ C. Eliminate all terminals beginning with if. D. Replace else by a nonterminal without changing the productions.
83.	Suppose grammar G_1 is LR(1), while grammar G_2 is LL(1). Which statement is necessarily true? A. Neither class is capable of representing deterministic context-free languages. B. Every LR(1) grammar is also LL(1). C. The two grammar classes are identical. D. Every LL(1) grammar is also LR(1).
84.	A process repeatedly accesses a small set of pages during each phase of execution. The set changes substantially when the phase changes. The number of frames allocated to the process is initially sufficient for one phase but insufficient for another. Which statement best explains the expected behavior? A. Page faults necessarily remain constant because virtual addresses do not change. B. The working set can change between phases, causing a sharp increase in page faults if the allocated frames cannot accommodate the current working set. C. The process cannot experience page faults once it has executed once. D. Increasing the number of processes always decreases the page-fault rate.
85.	A bounded buffer contains N slots. Initially it is empty. A producer executes wait(empty) before inserting an item, while a consumer executes wait(full) before removing one. Which invariant is directly represented by these semaphore operations? A. The producer can insert at most N items without corresponding removals. B. The consumer can always remove an item even when the buffer is empty. C. empty + full must always equal zero. D. Mutual exclusion is guaranteed even if no mutex protects the buffer itself.
86.	A system has several resource types and uses the Banker's algorithm. A process requests resources, but granting the request would leave the system in a state from which no safe sequence can be constructed, although no process is currently

	deadlocked. What should the resource manager do? A. Grant the request because no deadlock currently exists. B. Deny or postpone the request because the resulting state is unsafe. C. Terminate the requesting process immediately. D. Convert the request into a lower-priority request.
87.	A system contains multiple processes and reusable resources. Suppose the system permits mutual exclusion, hold-and-wait, and no preemption, but the resource-allocation graph contains no cycle. What can be concluded? A. Deadlock must occur. B. Deadlock is impossible in every resource model. C. The necessary conditions are incomplete for establishing deadlock; absence of a cycle can rule out deadlock in the single-instance resource case. D. Every process is necessarily starved.
88.	A process has three-page frames and references pages in the following order: 1, 2, 3, 1, 4 Under LRU replacement, when page 4 is referenced, which page is replaced? A. Page 1 B. Page 2 C. Page 3 D. Page 4

89.	Consider:
	`if (p)`
	`  x = 5;`
	`else`
	`  x = 7;`
	`y = x + 1;`
	Assume p is not known at compile time.
	What constant can safely be propagated to y?
	A. x = 5
	B. x = 7
	C. x = 6
	D. No single constant value for x can be propagated to y

90.	A B+ tree stores data-record pointers only at the leaf level, while internal nodes contain separator keys and child pointers. Why does this organization particularly support efficient range queries?

	A. Internal nodes contain complete records B. Leaf nodes can be linked, allowing sequential traversal of the relevant key range C. Every search requires scanning the entire tree D. Range queries bypass the index entirely
91.	Consider: SELECT * FROM R WHERE A NOT IN (SELECT B FROM S); If S.B contains at least one NULL, which statement is MOST accurate under standard SQL three-valued logic? A. The NULL is ignored automatically B. Every tuple of R necessarily satisfies the predicate C. The presence of NULL can cause the predicate to evaluate to UNKNOWN for candidate values not matching a non-NULL value D. The query is syntactically invalid
92.	Consider relation $R(A,B,C)$with: $AB \rightarrow C$ $C \rightarrow B$ Assume the candidate keys are AB and AC. What is the highest normal form satisfied by R? A. 1NF only B. 2NF but not 3NF C. 3NF but not BCNF D. BCNF
93.	A relation $R(A,B,C)$is decomposed into: $R_1(A,B)$ and $R_2(B,C)$ Suppose the functional dependency $B \rightarrow A$ holds in R. Which conclusion is justified? A. The decomposition is necessarily lossy B. The decomposition is lossless because the common attribute B functionally determines R_1 C. The decomposition cannot be lossless unless $A \rightarrow B$ D. Losslessness depends only on the number of attributes
94.	Consider the following schedule involving two transactions operating on data item (X): T1: $R_1(X)$, $W_1(X)$ T2: $R_2(X)$, $W_2(X)$ Suppose the actual interleaving is:

	$R_1(X)$, $R_2(X)$, $W_1(X)$, $W_2(X)$ Which statement about this schedule is TRUE? A. The schedule is conflict-equivalent to every possible serial execution B. Read operations do not participate in conflict analysis, so the schedule is serializable C. The schedule is serial because operations from each transaction are grouped together D. The schedule has a cycle in its precedence graph and is NOT conflict-serializable
95.	Three wireless nodes A, B, C have these properties: • A and C are both within range of B • A and C are NOT within range of each other • A transmits at 100 mW, C transmits at 10 mW • B can hear both A and C clearly When A is transmitting to B, what happens if C tries to transmit to B? A. C detects A's transmission and defers (no collision) B. C cannot detect A, transmits, collision at B C. C's signal is too weak, no collision at B D. B uses CDMA to separate both signals
96.	A host with IP address 192.168.1.10, belonging to the private network 192.168.1.0/24 behind NAT1, sends a packet to an Internet server. The packet passes through a second NAT (NAT2, a carrier-grade NAT) before reaching the server. NAT2 translates the packet's source IP address to 203.0.113.50, so the server sees 203.0.113.50 as the source IP address. When the server sends a reply, which IP address does it use as the destination address? A. 192.168.1.10 (the host's original private IP address) B. NAT1's external/WAN-side IP address (the address visible to NAT2) C. 203.0.113.50 (NAT2's public IP address seen by the server) D. 255.255.255.255 (broadcast address)
97.	A routing table has these entries: • 192.168.0.0/16 → Interface A • 192.168.1.0/24 → Interface B • 192.168.1.128/25 → Interface C • 0.0.0.0/0 → Interface D (default) For destination IP **192.168.1.200**, which interface is selected? A. Interface C B. Interface B C. Interface A D. Interface D
98.	A CRC uses a generator polynomial $G(x)$. An error pattern $E(x)$occurs during

	transmission. Under ideal CRC operation, which condition guarantees that the error is not detected? A. $E(x)$has odd weight B. $E(x)$has more bits than $G(x)$ C. $E(x)$is exactly divisible by $G(x)$ D. $E(x)$contains at least one burst
99.	Consider the following sequence of events: 1. A packet is forwarded through several routers. 2. Its destination IP address corresponds to the intended host. 3. The packet reaches that host successfully. 4. The data is nevertheless delivered to an unintended application process on that host. Which interpretation is MOST accurate? A. Network-layer logical addressing and routing failed, because process delivery was incorrect. B. Network-layer logical addressing and routing succeeded, but transport-layer demultiplexing did not identify the intended process. C. Transport-layer multiplexing succeeded, but physical-layer addressing failed. D. Application-layer addressing determines the IP route, so an application-level error necessarily implies routing failure.
100.	A TCP sender has: • rwnd = 24 KB • cwnd = 40 KB There are already 15 KB of unacknowledged bytes outstanding. Ignoring other TCP limitations, what is the maximum additional amount of data that can be sent immediately? A. 9 KB B. 15 KB C. 24 KB D. 40 KB