NATIONAL TESTING AGENCY(NTA)

UGC

NET/SET/JRF

COMPUTER SCIENCE

(PAPER-II)

12 YEARS (2015 - JAN 2026)

TOPIC WISE SORTED PREVIOUS YEAR QUESTIONS WITH DETAILED EXPLANATIONS

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PREFACE

It is with great pleasure that we present to you the **UGC-NET Computer Science and Applications PYQ Book**, a comprehensive resource that consolidates the past 12 years of exam questions along with detailed solutions. This book is designed to meet the needs of aspirants aiming for success in the UGC-NET examination, whether for JRF or Assistant Professorship.

The UGC-NET exam requires both an in-depth understanding of core concepts and the ability to apply this knowledge across various topics. With this in mind, this book provides solutions to past 12 years of exam questions, enabling students to strengthen specific areas of the syllabus while gaining practical insight into exam patterns and question trends.

Key features of the book include:

- **Comprehensive PYQ Collection:** Covering all questions from the past 12 years (2015–2026), helping students become familiar with the question types and exam pattern.
- **Topic wise and Year wise sorting:** Book includes **ten chapters**. Each chapter is **subdivided into units** for clear topic segmentation, **with questions sorted year-wise** to highlight the progression of concepts and formats over time.
- **Detailed Solutions:** Each question is accompanied by an in-depth explanation, clarifying the underlying concepts and reasoning behind the correct answers to enhance understanding of the subject matter.

The book not only serves as a tool for practicing questions but also helps build a solid foundation in core concepts. This structured approach will assist in sharpening analytical skills, which are essential for excelling in the exam.

We hope that this book becomes an indispensable part of your UGC-NET preparation journey and helps you achieve the success you aim for. We are confident that with diligent study and consistent practice, you will be well-prepared to face the challenges of the exam.

Best of luck on your path to success!

UGC NET COMPUTER SCIENCE & APPLICATIONS
{Exam Pattern}

Paper	Subject	Number of questions	Maximum marks	Marking scheme
Paper 1	Teaching Aptitude, Research Aptitude, Reading Comprehension, Communication, Reasoning (including Maths), Logical Reasoning, Data Interpretation, Information & Communication Technology (ICT), People & Environment, Higher Education System	50	100	+2 marks for the correct answer. No negative marking is applicable.
Paper 2	Computer Science and Applications	100	200	+2 marks for the correct answer. No negative marking is applicable.

CUT OFF

Year	Category	Unreserved	OBC(NCL)	EWS	SC	ST	PWD
Dec 2025	JRF & Assistant Professor	192	176	182	168	166	152
	Assistant Professor	162	146	148	140	138	128
June 2025	Assistant Professor	158	142	144	136	136	-
	JRF	186	172	172	158	160	-
Dec 2024	Assistant Professor	172	156	156	150	148	-
	JRF	198	186	188	174	178	-
June 2024	Assistant Professor	188	174	172	164	164	-
	JRF	218	206	202	194	196	-
Dec 2023	Assistant Professor	160	144	146	138	138	-
	JRF	184	174	176	160	164	-
June 2023	Assistant Professor	156	144	140	136	132	-
	JRF	174	162	162	152	152	-

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NUMBER OF QUESTIONS ASKED IN UGC NET - COMPUTER SCIENCE
(DEC 2015 to JAN 2026)

UNIT-1		2015	2016	2017		2018		2019		2020	2021	2022	2023		2024		2025	2026
DISCRETE STRUCTURES & OPTIMIZATION		DEC	JUL	JAN	NOV	JUL	DEC	JUN	DEC	JUN	JUN	OCT	JUN	DEC	AUG	DEC	JUN	JAN
1.1	Mathematical Logic	6	1	3	7	6	3	2	1	5	3	4	2	7	4	2	3	3
1.2	Sets and Relations	-	2	2	-	2	1	1	3	2	1	1	1	1	1	1	-	-
1.3	Counting, Mathematical Induction and Discrete Probability	7	1	2	3	2	3	2		5	8	1	1	1	3	1	3	1
1.4	Group Theory	1	-	-	-	-	-	2	1	-	1	1	-	1	-	1	1	3
1.5	Graph Theory	3	4	1	-	1	2	3	7	1	3	-	3	1	2	2	-	2
1.6	Boolean Algebra	-	-	-	-	-	2	2	-	-	1	2	1	-	-	1	-	1
1.7	Optimization	2	3	2	1	2	1	1	3	1	1	1	-	5	-	1	-	3

DISCRETE STRUCTURES AND OPTIMIZATION

SECTION 1

- **Mathematical Logic:** Propositional and Predicate Logic, Propositional Equivalences, Normal Forms, Predicates and Quantifiers, Nested Quantifiers, Rules of Inference.
- **Sets and Relations:** Set Operations, Representation and Properties of Relations, Equivalence Relations, Partially Ordering.
- **Counting, Mathematical Induction and Discrete Probability:** Basics of Counting, Pigeonhole Principle, Permutations and Combinations, Inclusion- Exclusion Principle, Mathematical Induction, Probability, Bayes' Theorem.
- **Group Theory:** Groups, Subgroups, Semi Groups, Product and Quotients of Algebraic Structures, Isomorphism, Homomorphism, Automorphism, Rings, Integral Domains, Fields, Applications of Group Theory.
- **Graph Theory:** Simple Graph, Multigraph, Weighted Graph, Paths and Circuits, Shortest Paths in Weighted Graphs, Eulerian Paths and Circuits, Hamiltonian Paths and Circuits, Planner graph, Graph Coloring, Bipartite Graphs, Trees and Rooted Trees, Prefix Codes, Tree Traversals, Spanning Trees and Cut-Sets.
- **Boolean Algebra:** Boolean Functions and its Representation, Simplifications of Boolean Functions.
- **Optimization:** Linear Programming - Mathematical Model, Graphical Solution, Simplex and Dual Simplex Method, Sensitive Analysis; Integer Programming, Transportation and Assignment Models, PERT-CPM: Diagram Representation, Critical Path Calculations, Resource Levelling, Cost Consideration in Project Scheduling.

CHAPTER 1

DISCRETE STRUCTURES & OPTIMIZATION

Unit 1.1: Mathematical Logic

Previous Year Exam Questions

(Dec 2015)

1. Which of the following argu ments are not valid?

(a) "If Gora gets the job and works hard, then he will be promoted. If Gora gets promotion, then he will be happy. He will not be happy, therefore, either he will not get the job or he will not work hard".

(b) "Either Puneet is not guilty or Pankaj is telling the truth. Pankaj is not telling the truth, therefore, Puneet is not guilty".

(c) If n is a real number such that n>1, then 2>1. Suppose that n^2>1, then >1.

Codes:

(1) (a) and (c) (2) (b) and (c)
(3) (a), (b) and (c) (4) (a) and (b)

(Dec 2015)

2. Let P(m, n) be the statement "m divides n" where the Universe of discourse for both the variables is the set of positive integers. Determine the truth values of the following propositions.

(A) $\exists m \forall n P(m,n)$
(B) $\forall n P(1,n)$
(C) $\forall m\ \forall n\ P(m,n)$
(1) (a)–True; (b) –true; (c)-false
(2) (a)-True; (b)-True; (c)-true
(3) (a)-False; (b)-False; (c)-False
(4) (a)-True; (b)-True; (c)-True

(Dec 2015)

3. Match the following terms:

List-I	List-II
(a) Vacuous proof	(i) A proof that the implication p→q is true based on the fact that p is false
(b) Trivial proof	(ii) A proof that the implication p→q is true based on the fact that q is true
(c) Direct proof	(iii) A proof that the implication p→q is true that proceeds by showing that q must be true when p is true
(d) Indirect proof	(iv) A proof that the implication p→q is true that proceeds by showing that p must be false when q is false

(1) (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)
(2) (a)-(ii), (b)-(iii), (c)-(i), (d)-(iv)
(3) (a)-(iii), (b)-(ii), (c)-(iv), (d)-(i)
(4) (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)

(Dec 2015)

4. Consider the compound propositions given below as:

(A) $pv{\sim}(p \wedge q)$
(B) $(p \wedge {\sim}q) \vee {\sim}(p \wedge q)$
(C) $P \wedge (p \vee r)$

Which of the above propositions are tautologies?

(1) (a) and (c) (2) (b) and (c)
(3) (a) and (b) (4) (a), (b) and (c)

(Dec 2015)

5. In Propositional Logic, given P and P→ Q, we can infer _____

(1) ~Q (2) Q
(3) PAQ (4) ~PAQ

(Dec 2015)

6. In constraint satisfaction problem, constraints can be stated as

(1) Arithmetic equations and inequalities that bind the values of variables
(2) Arithmetic equations and inequalities that doesn't bind any restriction over variables
(3) Arithmetic equations that impose restrictions over variables
(4) Arithmetic equations that discard constraints over the given variables

(July 2016)

7. Consider the statement,
"Either $-2 \leq x \leq -1$ or $1 \leq x \leq 2$".
The negation of this statement is

(1) $x < -2\ or\ 2 < x$ or $-1 < x < 1$
(2) $x < -2\ or\ 2 < x$
(3) $-1 < x < 1$
(4) $x \leq -2\ or\ 2 < x$ or $-1 < x < 1$

(Jan 2017)

8. Match the following:

List-I	List-II
a. Absurd	i. Clearly impossible being contrary to some evident truth.

b. Ambiguous	ii. Capable of more than one interpretation or meaning.
c. Axiom	iii. An assertion that is accepted and used without a proof.
d. Conjecture	iv. An opinion preferably based on some experience or wisdom.

Codes:

(1) a-i, b-ii, c-iii, d-iv (2) a-i, b-iii, c-iv, d-ii

(3) a-ii, b-iii, c-iv, d-i (4) a-ii, b-i, c-iii, d-iv

(Jan 2017)

9. In propositional logic if (P→ Q) ∧ (R→S) and (P ∨ R) are two premises such that

$(P \rightarrow Q) \wedge (R \rightarrow S)$

$P \vee R$

_____

_____Y_____

Y is the premise:

(1) $P \vee R$ (2) $P \vee S$

(3) $Q \vee R$ (4) $Q \vee S$

(Jan 2017)

10. Which of the following statements is true?

(1) The sentence S is a logical consequence of S_1,..., S_n if and only if $S_1 \wedge S_2 \wedge \ldots\ldots \wedge S_n \rightarrow S$ is satisfiable.

(2) The sentence S is a logical consequence of S_1,..., S_n if and only if $S_1 \wedge S_2 \wedge \ldots\ldots \wedge S_n \rightarrow$Sis valid.

(3) The sentence S is a logical consequence of S_1,... S_n if and only if $S_1 \wedge S_2 \wedge \ldots . \wedge S_n \wedge \neg S$ is consistent.

(4) The sentence S is a logical consequence of S_1,..., S_n if and only if $S_1 \wedge S_2 \wedge \ldots\ldots \wedge S_n \wedge S$ is inconsistent.

11. The first order logic (FOL) statement $((R \vee Q) \vee (P \vee \neg Q))$ is equivalent to which of the following?

(1) $((R \vee \neg Q) \wedge (P \vee \neg Q) \wedge (R \vee P))$

(2) $((R \vee Q) \wedge (P \vee \neg Q) \wedge (R \vee P))$

(3) $((R \vee Q) \wedge (P \vee \neg Q) \vee (R \vee \neg P))$

(4) $((R \vee Q) \wedge (P \vee \neg Q) \wedge (\neg R \vee P))$

(Nov 2017)

12. If the time is now 4 O'clock, what will be the time after 101 hours from now?

(1) 9 O'clock (2) 8 O'clock

(3) 5 O'clock (4) 4O'clock

(Nov 2017)

13. Let $A = \begin{bmatrix} 1 & 1 & 0 \\ 0 & 1 & 0 \\ 1 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ and $B = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 1 & 0 \\ 1 & 0 & 1 & 1 \end{bmatrix}$ Find the Boolean product $A \odot B$ of the two matrices.

(1) $\begin{bmatrix} 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 0 \\ 1 & 1 & 1 & 0 \\ 1 & 0 & 1 & 1 \end{bmatrix}$ (2) $\begin{bmatrix} 1 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 \\ 1 & 1 & 1 & 0 \\ 1 & 0 & 1 & 1 \end{bmatrix}$

(3) $\begin{bmatrix} 1 & 1 & 0 & 1 \\ 0 & 1 & 1 & 0 \\ 1 & 1 & 1 & 0 \\ 1 & 0 & 1 & 1 \end{bmatrix}$ (4) $\begin{bmatrix} 1 & 1 & 1 & 0 \\ 0 & 1 & 1 & 0 \\ 1 & 0 & 1 & 1 \\ 1 & 0 & 1 & 1 \end{bmatrix}$

(Nov 2017)

14. Let P and Q be two propositions, $\neg(P \leftrightarrow Q)$ is equivalent to:

(1) $P \leftrightarrow \neg Q$ (2) $\neg P \leftrightarrow Q$

(3) $\neg P \leftrightarrow \neg Q$ (4) $Q \rightarrow P$

(Nov 2017)

15. Negation of the proposition $\exists x\, H(x)$ is:

(1) $\exists\, x \neg H(x)$ (2) $\forall\, x \neg H(x)$

(3) $\forall\, x\, H(x)$ (4) $\neg\, x\, H(x)$

(Nov 2017)

16. Let P, Q, R and S be Propositions. Assume that the equivalences Pes $(Q \vee \neg Q)$ and $Q \Leftrightarrow R$ hold. Then the truth value of the formula $(P \wedge Q) \Rightarrow ((P \wedge R) \vee S)$ is always:

(1) True

(2) False

(3) Same as truth table of Q

(4) Same as truth table of S

(Nov 2017)

17. "If X, then Y unless Z" is represented by which of the following formulae in propositional logic?

(1) $(X \wedge Y) \rightarrow \neg Z$ (2) $(X \wedge \neg Z) \rightarrow Y$

(3) $X \rightarrow (Y \wedge \neg Z)$ (4) $Y \rightarrow (X \wedge \neg Z)$

(Nov 2017)

18. Consider the following two well-formed formulas in prepositional logic.

F1: $P \Rightarrow \neg P$

F2: $(P \Rightarrow \neg P) \vee (\neg P \Rightarrow P)$

Which of the following statements is correct?

(1) F1 is Satisfiable, F2 is valid

(2) F1 is unsatisfiable, F2 is Satisfiable

(3) F1 is unsatisfiable, F2 is valid

(4) F1 and F2 both are Satisfiable

(July 2018)

19. Consider a vocabulary with only four propositions A, B, C and D. How many models are there for the following sentence?

BVC

(1) 10 (2) 12

(3) 15 (4) 16

(July 2018)

20. Consider the following statements:

(a) False = True

(b) If a = $(\beta \wedge \gamma)$ then $a| = ß$ and $a| = y$.

Which of the following is correct with respect to the above statements?

(1) Both statement (a) and statement (b) are false.

(2) Statement (a) is true but statement (b) is false.

(3) Statement (a) is false but statement (b) is true.

(4) Both statement (a) and statement (b) are true.

(July 2018)

21. Consider the following English sentence:

"Agra and Gwalior are both in India".

A student has written a logical sentence for the above English sentence in First-Order Logic using predicate In(x, y), which means x is in y, as follows: In (Agra, India) V In(Gwalior, India).

Which one of the following is correct with respect to the above logical sentence?

(1) It is syntactically valid but does not express the meaning of the English sentence.

(2) It is syntactically valid and expresses the meaning of the English sentence also.

(3) It is syntactically invalid but expresses the meaning of the English sentence.

(4) It is syntactically invalid and does not express the meaning of the English sentence.

(July 2018)

22. A knowledge base contains just one sentence, 3x $AsHighAs$ (r, Everest). Consider the following two sentences obtained after applying existential instantiation.

(a) $AsHighAs$ (Everest, Everest)

(b) $AsHighAs$ (Kilimanjaro, Everest)

Which of the following is correct with respect to the above sentences?

(1) Both sentence (a) and sentence (b) are sound conclusions.

(2) Both sentence (a) and sentence (b) are unsound conclusions.

(3) Sentence (a) is sound but sentence (b) is unsound.

(4) Sentence (a) is unsound but sentence (b) is sound.

(July 2018)

23. The equivalence of

¬ ∃xQ(x) is:

(1) $\exists x \neg Q(x)$ (2) $\forall x \neg Q(x)$

(3) $\neg \exists x \neg Q(x)$ (4) $\forall x Q(x)$

(July 2018)

24. Match the following in List - I and List - II, for a function f:

List-I	List-II
$\forall x \forall y (f(x) = f(y) \rightarrow x = y$	(i) Constant
$\forall y \exists x (f(x) = y$	(ii) Injective
$\forall x f(x) = K$	(iii) Subjective

(1) (a)-(i), (b)-(ii), (c)-(iii)

(2) (a)-(iii), (b)-(ii), (c)-(i)

(3) (a)-(ii), (b)-(i), (c)-(iii)

(4) (a)-(ii), (b)-(iii), (c)-(i)

(Dec 2018)

25. In mathematical logic, which of the following are statements?

(i) There will be snow in January.

(ii) What is the time now?

(iii) Today is Sunday.

(iv) You must study Discrete Mathematics.

Choose the correct answer from the code given below:

(1) (i) and (iii) (2) (i) and (ii)

(3) (ii) and (iv) (4) (iii) and (iv)

(Dec 2018)

26. Consider a vocabulary with only four propositions A, B, C and D. How many models are there for the following sentence?

¬ Av ¬ BV ¬ CV ¬ D

(1) 7 (2) 8

(3) 15 (4) 16

(Dec 2018)

27. Consider the sentence below.

"There is a country that borders both India and Nepal."

Which of the following represents the above sentence correctly?

(1) ∃c Country(c) ^ Border(c, India) ^ Border(c, Nepal)

(2) ∃c Country(c) ⇒ [Border(c, India) ^ Border(c, Nepal)]

(3) [∃e Country(c)] → [Border(c, India) ^ Border(c, Nepal)]

(4) ∃c Border(Country(c), India ^ Nepal)

(June 2019)

28. Which of the following is principal conjunctive normal form for $[(p \vee q) \wedge \neg p \rightarrow \neg q]$?

(1) $p \vee \neg q$ (2) $p \vee q$

(3) $\neg p \vee q$ (4) $\neg p \vee \neg q$

(June 2019)

29. Match List-I with List-II:

List – I	List – II
(a) $p \rightarrow q$	(i) $\neg(q \rightarrow \neg p)$
(b) $p \vee q$	(ii) $p \wedge \neg q$
(c) $p \wedge q$	(iii) $\neg p \rightarrow q$
(d) $\neg(p \rightarrow q)$	(iv) $\neg p \vee q$

Choose the correct option from those given below:

(1) (a)-(ii); (b)-(iii); (c)-(i); (d)-(iv)

(2) (a)-(ii); (b)-(i); (c)-(iii); (d)-(iv)

(3) (a)-(iv); (b)-(i); (c)-(iii); (d)-(ii)

(4) (a)-(iv); (b)-(iii); (c)-(i); (d)-(ii)

(Dec 2019)

30. Consider the following statements:

S_1: $\forall x\, P(x) \vee \forall x Q(x)$ *and* $\forall x\, (P(x) \vee Q(x))$ are not logically equivalent.

S_2: $\exists x\, P(x) \wedge \exists x\, Q(x)$ *and* $\exists x\, (P(x) \wedge Q(x))$ are not logically equivalent

Which of the following statements is/are correct?

(1) Only S_1 (2) Only S_2

(3) Both S_1 and S_2 (4) Neither S_1 nor S_2

(June 2020)

31. Which of the following pairs of propositions are not logically equivalent?

(1) $((p + r) \wedge (qr))$ *and* $((pVq) \rightarrow r)$

(2) $p \leftrightarrow q \; and \; (-p \leftrightarrow -q)$
(3) $\big((p \wedge q) \vee (-p \wedge -q)\big) and \; p \leftrightarrow q$
(4) $\big((p \wedge q) \rightarrow r\big) and \; ((p \rightarrow r) \wedge (q \rightarrow r))$

(June 2020)

32. If $f(x) = x$ is my friend, and $p(x) = x$ is perfect. then correct logical translation of the statement "some of my friends are not perfect" is ____

(1) $\forall_x (f(x) \wedge \neg p(x))$
(2) $\exists_x (f(x) \wedge \neg p(x))$
(3) $\neg (f(x) \wedge \neg p(x))$
(4) $\exists_x (\neg f(x) \wedge \neg p(x))$

(June 2020)

33. What kind of clauses are available in conjunctive normal form?

(1) Disjunction of literals
(2) Disjunction of variables
(3) Conjunction of literals
(4) Conjunction of variables.

(June 2020)

34. Consider the following argument with premise $\forall_x (\boldsymbol{P}(x) \; \boldsymbol{vQ}(x))$ and conclusion $(\forall_x \boldsymbol{P}(x))\wedge(\forall_x \boldsymbol{Q}(x))$

(A) $\forall_x \; (P(x) \; vQ(x))$	Premise
(B) $P(c) \; VQ(c)$	Universal instantiation from (A)
(C) $P(c)$	Simplification from (B)
(D) $\forall_x P(x)$	Universal Generalization of (C)
(E) $Q(c)$	Simplification from (B)
(F) $\forall_x \; Q(x)$	University Generalization of (E)
(G) $\forall_x p(x))\wedge(\forall_x Q(x))$	Conjunction of (D) and (F)

(1) This the valid argument
(2) Steps (C) and (E) are not correct inference
(3) Steps (D) and (F) are not correct inferences
(4) Step (G) is not a correct inference

(June 2020)

35. Consider the statement below.

A person who is radical (R) is electable (E) id he/she is conservative (C), but otherwise is not electable
Few probable logical assertions of the above sentence are given below.
(A) $(R \wedge E) \Leftrightarrow C$
(B) $R \Rightarrow (E \Leftrightarrow C)$
(C) $R \Rightarrow ((C \Rightarrow E) \vee \neg E$
(D) $(\neg RV \neg E \vee C) \wedge R \vee \neg C \vee E)$

Which of the above logical assertions are true?
Choose the correct answer from the options given below:

(1) (B) only (2) (C) only
(3) (A) and (C) only (4) (B) and (D) only

(June 2021)

36. Which of the following are logically equivalent?

A. $\neg$p $\rightarrow$ (q $\rightarrow$ r)and q $\rightarrow$ (pvr)
B. $(P \rightarrow q) \rightarrow r \; and \; p \rightarrow (q \rightarrow r)$
C. $(p \rightarrow q) \rightarrow (r \rightarrow s) and (p \rightarrow r) \rightarrow (q \rightarrow s)$

Choose the correct answer form the options given below:

(1) A only (2) A and B only
(3) B and C only (4) A and C only

(June 2021)

37. Given below are two statements, one is labelled as Assertion A and the other is labelled as Reason R

Assertion A: Teachers should accept students as they are and with whatever cognitive level they have.
Reason R: Moralizing, being judgemental, exposing ignorance are barriers to successful communication.
In light of the above statements, choose the correct answer from the options given below

(1) Both A and R are true and R is the correct explanation of A
(2) Both A and R are true but R is NOT the correct explanation of A
(3) A is true but R is false
(4) A is false but R is true

(June 2021)

38. Consider the sentence below.

There is a country that borders both india and Pakistan.
Which of the following logical expressions express the above sentence correctly when the predicate Country(x) represents that x is a country and Borders(x, y) represents that the countries

(1) $\exists$ c Coutry(c) $\wedge$ Border (c, India) $\wedge$ Border(c, Pakistan)
(2) $\exists$ c Coutry(c) $\Rightarrow$ Border (c, India) $\wedge$ Border(c, Pakistan)
(3) [$\exists$ c Coutry(c)] $\Rightarrow$ [Border (c, India) $\wedge$ Border(c, Pakistan)]
(4) $\exists$ cCoutry(c), India $\wedge$ Pakistan)

(Oct 2022)

39. Consider α: β: γ as logical variables. Identity which of the following represents erect logies equivalence

(A) $\big(\alpha \wedge (\beta \vee \gamma)\big) = ((\alpha \wedge \beta) \vee (\alpha \wedge \gamma)$
(B) $(\alpha \wedge \beta) = -\alpha \vee \beta$
(C) $(\alpha \Longrightarrow \beta) = (-\beta \Longrightarrow -a)$
(D) $(-(\alpha \vee \beta)) = (-a \Longrightarrow -\beta)$

Choose the correct answer from the options given below:

(1) (A) and (D) only (2) (B) and (C) caly
(3) (A) and (C) only (4) (B and D) only

(Oct 2022)

40. Given below are two statements: one is labelled as Assertion (A) and the other is labelled as Reason (R)

Assertion (A): $\bar{P}$
Reason (R): $(r \rightarrow \bar{q}, r \vee s, s \rightarrow \bar{q}, p \rightarrow q)$

In the light of the shove statement, choose the correct answer from the options given below:

(1) Both (A) and (B) are true and (B) is the correct explanation of (A)

(2) Both (A) and (R) see true but (R) is NOT the correct explanation of (A)

(3) (A) is true but (R) is f

(4) (A) is false but (R) is

(Oct 2022)

41. Of the following, which is NOT a logical error?

(1) Using the '='instead of'==' to determine if two rales equal

(2) Divide by zero

(3) Failing to initialize counter and total variables before the body of loop

(4) Using commas instead of two required semicolon in a for loop header

(Oct 2022)

42. Given below are two statements:

Statement I: "Grandparent is a parent of one's parent"

Statement II: First Order Predicate Logic (FOPL) representation of above statement is

$\forall g.c$ Grandparent $(g.c)p$ parent (g.p) $\wedge$ $parent\ (p.c)$

In the light of the above statements, choose the most appropriate answer from the options given below:

(1) Both Statement and Statement II are correct

(2) Both Statement I and Statement II are incorrect

(3) Statement is correct but Statement II is incorrect

(4) Statement is incorrect but Statement II is correct

(June 2023)

43. The negation of "Some students like hockey" is:

(1) Some students dislike hockey

(2) Every student dislike hockey

(3) Every student like hockey

(4) All students like hockey

(June 2023)

44. Four persons: P, Q, R and S are in police custody and one of them has committed a crime. They confess as follows:

A. Person P: Q did it.

B. Person Q: S did it.

C. Person R: I did not do it.

D. Person S: Q lied.

If exactly one of the statements is false, which of the following is the guilty person.

(1) P (2) Q

(3) R (4) S

(Dec 2023)

45. Arrange the following in ascending order:

(A) Remainder of 49^{16} when divided by 17

(B) Remainder of 2^{446} when divided by 9

(C) Remainder of 155^{17} when divided by 17

(D) Last digits of the number 7^{45}

Choose the correct answer from the options given below:

(1) (A), (B), (C), (D) (2) (A), (B), (D), (C)

(3) (A), (C), (B), (D) (4) (D), (C), (B), (A)

(Dec 2023)

46. The statement $P(x)$: $''x = x^{2}''$. If the universe of disclosure consists of integers, what are the following have truth values:

(A) $P(0)$

(B) $P(1)$

(C) $P(2)$

(D) $\exists x\ P(x)$

(E) $\forall x\ P(x)$

Choose the correct answer from the options given below:

(1) (A), (B) and (E) Only (2) (A), (B) and (C) Only

(3) (A), (B) and (D) Only (4) (B), (C) and (D) Only

(Dec 2023)

47. If universe of disclosure are all real numbers, then which of the following are true?

(A) $\exists x\ \forall y\ (x + y = y)$

(B) $\forall x\ \forall y\ \Big(\big((x \geq 0) \wedge (y < 0)\big) \rightarrow (x - y > 0)\Big)$

(C) $\exists x\ \exists y\ \Big(\big((x \leq 0) \wedge (y \leq 0)\big) \wedge (x - y > 0)\Big)$

(D) $\forall x\ \forall y((x \neq 0) \wedge (y \neq 0) \leftrightarrow (xy \neq 0))$

Choose the correct answer from the options given below:

(1) (A) and (B) Only

(2) (A), (C) and (D) Only

(3) (A), (B) and (D) Only

(4) (A), (B), (C) and (D) Only

(Dec 2023)

48. Which of the following statement are truth statements if universe of disclosure is set of integers:

(A) $\forall \mathrm{n}(\mathrm{n}^2 \geq 0)$ (B) $\exists \mathrm{n}(\mathrm{n}^2 = 2)$

(C) $\forall \mathrm{n}(\mathrm{n}^2 \geq \mathrm{n})$ (D) $\exists n(n^2 < 0)$

Choose the correct answer from the options given below:

(1) (A) and (B) Only (2) (B) and (C) Only

(3) (C) and (D) Only (4) (A) and (C) Only

(Dec 2023)

49. Match List - I with List - II.

List – I	List - II
Propositions	Disjunctive Normal Form (DNF)
(A) $\mathrm{P} \wedge (\mathrm{P} \rightarrow Q)$	(I) $\mathrm{P} \vee Q$
(B) $\neg(\mathrm{P} \vee Q) \rightarrow (\mathrm{P} \wedge Q)$	(II) $(\mathrm{P} \wedge \neg \mathrm{P}) \vee (\mathrm{P} \wedge Q)$
(C) $P \rightarrow Q$	(III) $(\neg P) \vee Q$
(D) $P \vee (Q \wedge R)$	(IV) $(\mathrm{P} \wedge \mathrm{P}) \vee (\mathrm{P} \wedge Q) \vee (\mathrm{P} \wedge \mathrm{R}) \vee (Q \wedge \mathrm{R})$

Choose the correct answer from the options given below:

(1) (A)-(I), (B)-(II), (C)-(III), (D)-(IV)
(2) (A)-(II), (B)-(I), (C)-(III), (D)-(IV)
(3) (A)-(III), (B)-(I), (C)-(II), (D)-(IV)
(4) (A)-(IV), (B)-(III), (C)-(II), (D)-(I)

(Dec 2023)

50. If the universe of disclosure is set of integers, then which of the followings are TRUE?

(A) $\forall n\ m(n^2 < m)$
(B) En Vm(n< m²)
(C) 3n Vm(nm=m)
(D) 3n 3m(n²+m²=6)
(E) 3n 3m(n+m=4 / n-m=1)

Choose the correct answer from the options given below:

(1) (A), (B) and (C) Only (2) (B) and (C) Only
(3) (C), (D) and (E) Only (4) (C) and (E) Only

(Dec 2023)

51. Which of the following are tautology?

(A) $\big(P \rightarrow (P \wedge Q)\big) \rightarrow (P \rightarrow Q)$
(B) $((P \rightarrow Q) \rightarrow Q) \rightarrow (P \vee Q)$
(C) $\big((P \vee \neg P) \rightarrow Q\big) \rightarrow \big((P \vee \neg P) \rightarrow R\big)$
(D) $\big(Q \rightarrow (P \wedge \neg P)\big) \rightarrow \big(R \rightarrow (P \vee \neg P)\big)$

Choose the correct answer from the options given below:

(1) (A) Only
(2) (B) Only
(3) (A) and (B) Only
(4) (C) and (D) Only

(Aug 2024)

52. Let P be "It is hot day" and q be "The temperature is 48° C". Write in simple sentences the meaning of ~p∧~q.

(1) It is hot day or temprature is 48˚C
(2) It is cold day or temprature is 48˚C
(3) It is neither a hot day nor temperature is 48˚C
(4) It is not a hot day

(Aug 2024)

53. Let L(x,y) be the statement " x loves y " where the domain for both x and y consists of all people in the world. Use quantifiers to express "Joy is loved by everyone".

(1) $\forall x$ L(x, Joy) (2) $\forall y$ L(Joy, y)
(3) $\exists y \forall x$ L(x, y) (4) $\exists x \neg$ L(Joy, x)

(Aug 2024)

54. Translate ∀x∃y(x<y) in English. Consider domain as a real number for both the variables.

(1) For all real numbers x, there exists a real number y such that x is less than y
(2) For every real numbers y, there exists a real number x such that x is less than y
(3) For some real numbers x, there exists a real number y such that x is less than y
(4) For each and every real numbers x and y, x is less than y

(Aug 2024)

55. Consider the following if p and q are two statements.

(A) $\sim (p \wedge q) \equiv \sim p \vee \sim q$
(B) $\sim (p \vee q) \equiv \sim p \wedge \sim q$
(C) p ∧~ p ≡ T
(D) ~ (p ⇒ q) ≡ p ∧~ q
(E) p ∨ q ≡~ p ∨~ q

Choose the correct answer from the options given below:

(1) (A), (B) and (D) Only
(2) (A), (C) and (D) Only
(3) (C), (D) and (E) Only
(4) (A), (B) and (C) Only

(Dec 2024)

56. The kind of symbols for basic syntactic elements of first-order logic are

A. Constant
B. Domain
C. Predicate
D. Temporal
E. Function

Choose the correct answer from the options given below:

(1) B, D only (2) A, B, C only
(3) A, C, E only (4) C, D only

(Dec 2024)

57. Match the LIST-I with LIST-II: Match the logical equivalence propositions

LIST-I	LIST-II
A. p → q	I. (p ∧ q) v (¬ P ∧ ¬ q)
B. ¬ (p ∨ (¬ p ∧ q))	II. ¬ p ∨ q
C. p ↔ q	III. ¬ (p ∨ q)
D. ¬ (p ↔ q)	IV. ¬ p ↔ q

Choose the correct answer from the options given below:

(1) A-I, B-III, C-II, D-IV (2) A-I, B-II, C-III, D-IV
(3) A-II, B-III, C-I, D-IV (4) A-II, B-III, C-IV, D-I

(June 2025)

58. Let P denote "She is intelligent" and let Q denote "She is happy."

Given below are the statements:

(a) If She is intelligent, then She is unhappy.
(b) She is neither intelligent nor happy.
(c) It is necessary to be not intelligent in order to be happy.
(d) To be not intelligent is to be unhappy.

Which of the following is correct Propositional expression for the above statements:

(1) P→ ¬Q; (b) P∧¬Q; (c) Q→ ¬P; (d) P→ ¬Q
(2) P→Q; (b) ¬P∧¬Q; (c) ¬Q→P; (d) ¬P → ¬Q
(3) P→¬Q; (b)¬P∧¬Q; (c) Q→ ¬P; (d) ¬P→ ¬Q
(4) P→¬Q; (b) P∧¬Q; (c) Q→P; (d) ¬P→ ¬Q

(June 2025)

59. Let m and n are positive integers. Then

(A) If n≠1, then m < mn.

(B) If k is composite, then k = mn where 1 <m, n>k

(C) If mn = 1, then m = 1 and n = 1.

(D) If k is composite, then k = mn where 1 < m,n<k

Which of the following is correct:

(1) (A), (C), (D) (2) (B), (C), (D)

(3) (A), (B) (4) (A), (B), (C)

(June 2025)

60. Match List I with List II

List I	List II
A. If the Indian team wins, then it is raining	I. Inverse
B. If the Indian team does not win, then it is not raining	II. Converse
C. If it is raining, then the Indian team wins	III. Contrapositive
D. If it is not raining, then the Indian team does not win	IV. Conditional

Choose the correct answer from the options given below:

(1) A-II, B-I, C-IV, D-III (2) A-III, B-I, C-II, D-IV

(3) A-II, B-III, C-IV, D-I (4) A-III, B-II, C-IV, D-I

(JAN 2026)

61. Which of the followings logical implications are tautology?

A. $[\sim p \wedge (p \vee q)] \rightarrow q$

B. $\sim p \rightarrow (p \rightarrow q)$

C. $[p \wedge (p \rightarrow q)] \rightarrow q$

D. $\sim (p \rightarrow q) \rightarrow q$

Choose the correct answer from the options given below:

(1) A & B Only (2) B & D Only

(3) A, B & C Only (4) B, C & D Only

(JAN 2026)

62. Which logic is designed to address the problem of referential opacity in propositional attitudes?

(1) Regular Logic (2) Modal Logic

(3) First-order logic (4) Predicate logic

(JAN 2026)

63. Which of the following statements are true if universe of discourse for all variables consist of all integers?

A. $\forall n \exists m(n^2 < m)$

B. $\exists n \exists m(n + m = 4 \wedge n - m = 2)$

C. $\exists n \exists m(n^2 + m^2 = 5)$

D. $\exists m \forall n(m + n = 0)$

E. $\forall m \exists n(m + n = 0)$

Choose the correct answer from the options given below:

(1) A, B & C Only (2) A, B, C & D Only

(3) A, B, C & E Only (4) B, C, E & D Only

ANSWER KEY									
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
(4)	(1)	(1)	(3)	(2)	(1)	(1)	(1)	(4)	(2)
11	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
(2)	(1)	(1)	(1)	(2)	(1)	(2)	(1)	(2)	(3)
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**
(1)	(4)	(2)	(4)	(1)	(3)	(1)	(1)	(4)	(3)
31	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
(4)	(2)	(1)	(2)	(4)	(1)	(1)	(1)	(3)	(1)
41	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**
(2)	(1)	(2)	(2)	(3)	(3)	(4)	(4)	(2)	(2)
51	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
(*)	(3)	(1)	(1)	(1)	(3)	(3)	(3)	(1)	(3)
61	**62**	**63**							
(3)	(2)	(3)							

EXPLANATIONS

1. Explanation: (4)

(a) Argument is valid: The argument follows the structure of modus tollens and De Morgan's Law. If "Gora gets the job and works hard, he will be promoted" and "If Gora is promoted, he will be happy," then "If he is not happy, he either did not get the job or did not work hard." This is a valid logical deduction.

(b) Argument is valid: The argument follows disjunctive syllogism. "Either Puneet is not guilty, or Pankaj is telling the truth. Pankaj is not telling the truth. Therefore, Puneet is not guilty." This is a valid deduction.

(c) Argument is invalid: The statement "If ($n^2 > 1$), then ($n > 1$)" is false. For example, if ($n = -2$), ($n^2 = 4$), but (n) is not greater than 1. Hence, the argument is invalid.

Therefore, the correct answer is (4) (a) and (b).

2. Explanation: (1)

- (A) $\exists m \forall n\, P(m,n)$: True. Take $(m = 1)$. Since $(1 \mid n)$ for all positive integers (n), such an (m) exists.
- (B) $\forall n\, P(1,n)$: True. (1) divides every positive integer (n).
- (C) $\forall m \forall n\, P(m,n)$: False. Counterexample: $(m = 2, n = 3)$. $(2 \nmid 3)$.

Therefore, the correct answer is:

(1) (a)–True; (b)–True; (c)–False

3. Explanation: (1)

The correct matching for the given terms is:

Answer: (1) (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)

4. Explanation: (3)

Let's check each proposition for tautology by breaking down their logic:

(A) $p \vee \neg(p \wedge q)$
Rewrite $\neg(p \wedge q)$ as $\neg p \vee \neg q$:
So (A) becomes: $p \vee (\neg p \vee \neg q) = (p \vee \neg p) \vee \neg q$
We know $p \vee \neg p$ is always true. Thus, (A) is always true — a tautology.

(B) $(p \wedge \neg q) \vee \neg(p \wedge q)$
Rewrite $\neg(p \wedge q)$ as $\neg p \vee \neg q$:
So (B) becomes: $(p \wedge \neg q) \vee (\neg p \vee \neg q)$
This simplifies (since $(p \wedge \neg q) \vee \neg q = \neg q \vee p$, and combined with $\neg p$) to always be true no matter the value of $p \; or \; q$. So (B) is also a tautology.

(C) $p \wedge (p \vee r)$
If p is true, the statement simplifies to True, but if p is false, $p \wedge anything$ is false. So it's not always true—NOT a tautology.
Correct option is (3): (a) and (b) are tautologies.

5. Explanation: (2)
In propositional logic, the expression P and $P \rightarrow Q$ implies that:

- P is true.
- $P \rightarrow Q$ is a conditional statement, which means if P is true, then Q must also be true.

Given that P is true and $P \rightarrow Q$ holds, we can directly infer Q must be true.
Thus, the correct answer is: $(2)\; Q$.

6. Explanation: (1) In a **constraint satisfaction problem (CSP)**, constraints are typically expressed in the form of arithmetic **equations** or **inequalities** that **bind** or **restrict** the values that the variables can take. These constraints impose conditions on the variables that need to be satisfied for a solution to be valid.

- **Option (1)** correctly states that the constraints can be **arithmetic equations and inequalities** that **bind the values of variables**, i.e., they impose restrictions on the possible values the variables can take.

So, Correct option is 1.

7. Explanation:

8. Explanation: (1)

- **Absurd**: Refers to something that is clearly impossible or contrary to an evident truth. This matches with **i. Clearly impossible being contrary to some evident truth**.
- **Ambiguous**: Refers to something that can be interpreted in more than one way. This matches with **ii. Capable of more than one interpretation or meaning**.
- **Axiom**: Refers to a statement or proposition that is accepted without proof. This matches with **iii. An assertion that is accepted and used without a proof**.
- **Conjecture**: Refers to an opinion or conclusion based on experience or wisdom but not proven. This matches with **iv. An opinion preferably based on some experience or wisdom**.

So, Correct option is 1.

9. Explanation: (4) From $(P \rightarrow Q) \wedge (R \rightarrow S)$ we have both implications $P \rightarrow Q \; and \; R \rightarrow S. Given \; P \; V \; R$, Consider the two cases.
If P holds, then Q follows, So $Q \; V \; S \; is \; true.$
If R holds, then S follows ,so Q V S is true.
In either case Q V S is true, so it is a valid conclusion.

10. Explanation: (2)
S is a logical consequences of $S_1, \ldots\ldots, S_n (written \; S_1, \ldots\ldots, S_n = S)$exactly when every model that satisfies $S_1 \wedge \ldots \wedge S_n) \rightarrow S$ is valid (true in every model).options (1),(3) and (4) are incorrect because they confuse validity/ unsatisfiability with satisfiability/consistency.

11. Explanation: (2)

12. Explanation: (1)

1. Divide 101 by 24 to find how many full days (24-hour periods) there are in 101 hours:
$101 \div 24 = 4 \; remainder \; 5$
So, 101 hours is equivalent to 4 full days and 5 extra hours.
2. Start from $4\; O'$clock and add the remaining 5 hours:

- $4 \; O'clock + 5 \; hours = 9 \; O'clock.$

The time will be $9\; O'$clock.
Thus, the correct answer is $(1)\; 9\; O'$clock.

13. Explanation:

14. Explanation: (1)
Known equivalences
$P \leftrightarrow Q \equiv (P \wedge Q) \vee (\neg P \wedge \neg Q)$.
Negating:$\neg(P \leftrightarrow Q) \equiv \neg((P \wedge Q) \vee (\neg P \wedge \neg Q))$
Apply De Morgan's Law
$\neg((P \wedge Q) \vee (\neg P \wedge \neg Q)) \equiv (\neg P \vee \neg Q) \wedge (P \vee Q)$.
This is exactly the exclusive OR:$\neg(P \leftrightarrow Q) \equiv P \oplus Q$.
Equivalences for $P \oplus Q$

- A common alternative is $P \oplus Q \equiv P \leftrightarrow \neg Q \equiv \neg P \leftrightarrow Q$.

Matching to the given options

- (1) $P \leftrightarrow \neg Q$ — equivalent to $P \oplus Q$.
- (2) $\neg P \leftrightarrow Q$ — also equivalent to $P \oplus Q$.
- (3) $\neg P \leftrightarrow \neg Q$ — not equivalent to $P \oplus Q$ (this is equivalent to $P \leftrightarrow Q$).
- (4) $Q \rightarrow P$ — equivalent to $\neg Q \vee P$, not generally equivalent to XOR.

So, both (1) and (2) are indeed equivalent forms for $\neg(P \leftrightarrow Q)$.

The common form is: $\neg(P \leftrightarrow Q) \equiv P \leftrightarrow \neg Q \equiv \neg P \leftrightarrow Q \equiv P \oplus Q$.
Correct answer: 1) $P \leftrightarrow \neg Q$

15. Explanation: (2)
We are asked to find the negation of the proposition: $[\exists\, x\,, H(x)]$
- The negation of an existential quantifier:
$$\neg\left(\exists\, x\,, H(x)\right) \equiv \forall\, x\,, \neg\, H(x)$$
- The negation of a universal quantifier:
$$\neg\left(\forall\, x\,, H(x)\right) \equiv \exists\, x\,, \neg\, H(x)$$

Apply the rule
$\neg\left(\exists\, x\,, H(x)\right) = \forall\, x\,, \neg\, H(x)$
Correct Answer: (2)$\forall\, x\,, \neg\, H(x)$

16. Explanation: (1) Because $(Q \vee \neg\, Q)$ is a tautology, $(P \equiv (Q \vee \neg\, Q))$ implies (P) is always True. Also $(Q \Leftrightarrow R)$ means $(R \equiv Q)$.
$(P \wedge Q) \Rightarrow \big((P \wedge R) \vee S\big) \equiv (T \wedge Q) \Rightarrow \big((T \wedge Q) \vee S\big) \equiv Q \Rightarrow (Q \vee S)$
But $(Q \Rightarrow (Q \vee S))$ is a tautology. Hence the formula is always True.

17. Explanation: (2)
"Y unless Z" means "if not Z, then Y" i.e. $(\neg\, Z \rightarrow Y)$.
So "If X, then (Y unless Z)" is $(X \rightarrow (\neg\, Z \rightarrow Y))$,
which is equivalent to $((X \wedge \neg\, Z) \rightarrow Y)$.
Correct Answer: (2)

18. Explanation: (1)
- $(F1\colon P \Rightarrow \neg\, P)$ is satisfiable (true when $(P = F)$; false when $(P = T)$).
- $(F2\colon (P \Rightarrow \neg\, P) \vee (\neg\, P \Rightarrow P) = (\neg\, P) \vee (P) = T)$, so valid.

Correct Answer: (1)

19. Explanation: (2)
With 4 propositions there are $2^4 = 16$ total assignments. $B \vee C$ is false only when $B = 0$ and $C = 0$; then A and D can be anything (4 assignments). Thus satisfying models $= 16 - 4 = 12$.
So, Correct option is 2.

20. Explanation: (3) Statement (a) is false but statement (b) is true.
- (a) "False ≡ True" is **false** (they're not equivalent).
- (b) From $\alpha = \beta \wedge \gamma$), we have $(\alpha \vDash \beta)\ and\ (\alpha \vDash \gamma)$ (conjunction elimination).

So, Correct option is 3.

21. Explanation:

22. Explanation: (4) Sentence (a) is unsound but sentence (b) is sound.
- From $\exists x$ AsHighAs(x,Everest), **existential instantiation** allows AsHighAs(c,Everest) only with a **fresh (new) constant** c not appearing in the KB.

(a) uses **Everest**, which already appears in the KB and also asserts a specific fact AsHighAs(Everest,Everest) not justified—**unsound**.
(b) uses **Kilimanjaro** as a **new constant name** (assuming it's not elsewhere in the KB), which is permitted—**sound** under EI.

23. Explanation: (2)

24. Explanation: (4)
List–I
(a) ∀x ∀y (f(x) = f(y) → x = y)
This means **if two outputs are equal, their inputs must be equal** —
Injective (one–one) function.
(b) ∀y ∃x (f(x) = y)
For every possible output (y), there exists some input (x) such that (f(x)=y).
Surjective (onto) function.
(c) ∀x f(x) = K
Function gives the same constant value (K) for all (x).
Constant function.
Correct Matching

(a)	(b)	(c)
(ii) Injective	(iii) Surjective	(i) Constant

25. Explanation: (1)
(i) "There will be snow in January." — declarative, truth-valued → statement.
(ii) "What is the time now?" — question → not a statement.
(iii) "Today is Sunday." — declarative, truth-valued → statement.
(iv) "You must study Discrete Mathematics." — imperative → not a statement.
Correct Answer: (1)

26. Explanation: (3) There are $2^4 = 16$ possible truth assignments for A, B, C, D.
The disjunction $A \vee B \vee C \vee D$ is false only when all four are false (one assignment).
So the number of satisfying models is $16 - 1 = 15$.
Correct Answer: (3) 15

27. Explanation: (1)

28. Explanation: (1)
Formula: $(\ (p \vee q\ ) \wedge \neg\, p\ ) \rightarrow \neg\, q$ ((p∨q)∧¬p)→¬q.
Implication →: ≡ $\neg\ [\ (\ p \vee q\ ) \wedge \neg\ p\ ] \vee \neg\ q$ ≡¬[(p∨q)∧¬p]∨¬q.
De Morgan: ¬ [($p \vee q$) ∧ ¬ p]

¬ ($p \vee q$) ∨ p
(¬ $p \wedge \neg\ q$) ∨ p ¬[(p∨q)∧¬p]=¬(p∨q)∨p=(¬p∧¬q)∨p.
Distribute/simplify: (¬ $p \wedge \neg\ q$) ∨ p
($p \vee \neg\ p$) ∧ ($p \vee \neg\ q$)
$p \vee \neg\ q$ (¬p∧¬q)∨p=(p∨¬p)∧(p∨¬q)=p∨¬q.
Final PCNF: $p \vee \neg\ q$ p∨¬q. — Option (1).

29. Explanation:
Let's match logically:
$(a)\ (p \rightarrow q\ \equiv \neg\ p\ V\ q)\ \rightarrow\ (iv)$
$(b)\ (p\ V\ q\ \equiv\ \neg p \rightarrow\ q)\ \rightarrow\ (iii)$
$(c)\ (p\ \wedge\ q\ \equiv\ \neg(q \rightarrow \neg\ p))\ \rightarrow\ (i)$
$(d)\ \neg(p \rightarrow q)\ \equiv\ p\ \wedge \neg q)\ \rightarrow\ (ii)$
Correct matching:
(a)-(iv); (b)-(iii); (c)-(i); (d)-(ii)

30. Explanation:

31. Explanation: (4)
- (2) $(p \leftrightarrow\ q \equiv\ \neg\ p \leftrightarrow \neg\ q)$ (equivalent).
- (3) $((p \wedge\ q) \vee (\neg\ p \wedge\ \neg\ q) \equiv\ p \leftrightarrow\ q)$ (equivalent).
- (1) $((p \vee\ r) \wedge (q \rightarrow\ r) \equiv\ (p \vee\ q) \rightarrow\ r)$ (equivalent identity).
- (4) $((p \wedge q) \rightarrow\ r)$ is not equivalent to $((p \rightarrow\ r) \wedge (q \rightarrow\ r))$.
  Counterexample: $(p = T, q = F, r = F)$:
  $((p \wedge\ q) \rightarrow\ r\ =\ T)$ (vacuously true), but $((p \rightarrow\ r) \wedge (q \rightarrow\ r) = (F) \wedge (T) = F)$.
  Correct Answer: (4)

32. Explanation: (2) Correct translation: $(\exists\ x, [f(x) \wedge\ \neg\ p(x)])$.
"Some" ⇒ there exists $(\exists)$.
"my friends" ⇒ restrict to those (x) with $(f(x))$ true.
"are not perfect" ⇒ $(\neg\ p(x))$.
So we need an (x) such that friend ∧ not perfect.
Why the others are wrong
(1) $(\forall\ x(f(x) \wedge\ \neg\ p(x))$: says all my friends are not perfect — too strong.
(3) $(\neg(f(x) \wedge\ \neg\ p(x))$: no quantifier; for a particular (x) it denies being both friend and not perfect — not the intended claim.
(4) $(\exists\ x(\neg\ f(x) \wedge \neg\ p(x)))$: says someone not my friend is not perfect — irrelevant.
Hence, option (2) is correct.

33. Explanation: (1)
In CNF, a formula is a conjunction (AND) of clauses, and each clause is a disjunction (OR) of literals (a literal = variable or its negation). Therefore, the clauses themselves are disjunctions of literals. Options $(2) - (4)$ are incorrect.
Correct Answer: (1) Disjunction of literals

34. Explanation: (2)
Reason: From $(P(c) \vee Q(c))$ you cannot infer $P(c)\ or\ (Q(c))$ by "simplification." Simplification applies to conjunctions $(P \wedge\ Q \Rightarrow\ P)$, not disjunctions. Once (C) and (E) fail, (D) and (F) don't follow—but the specific incorrect rule use is in (C) and (E).
Correct Answer: (2) Steps (C) and (E) are not correct inferences

35. Explanation: Translate the English
- "Radical people are electable iff conservative; otherwise not"
  $\Rightarrow\ (R \Rightarrow\ (E \Leftrightarrow\ C))$.
  Check each option

(A) $((R \wedge\ E) \Leftrightarrow\ C)$: False. Counterexample: $(R = F, C = T, E = T)$. RHS true, LHS false.
(B) $(R \Rightarrow (E \Leftrightarrow\ C))$: True. Exactly the translation above.
(C) $(R \Rightarrow ((C \Rightarrow\ E) \vee\ \neg\ E))$: Not a faithful assertion. Inside simplifies to a tautology: $((C \Rightarrow\ E) \vee \neg\ E \equiv \top)$. So it says $(R \Rightarrow \top)$ (always true, but doesn't capture the sentence).
(D) $(\neg\ R \vee\ \neg\ E \vee\ C) \wedge\ (\neg\ R \vee \neg\ C \vee E)$: True. This is just (B) in CNF form.
Answer: (B) and (D).

36. Explanation: (1)
$A. \neg p \rightarrow (q \rightarrow\ r) \equiv\ p\ V(\neg\ q\ V\ r) = p\ V \neg\ q\ V\ r).$
$(; q \rightarrow (p\ V\ r) \equiv \neg\ q\ V\ p\ V\ r = p\ V \neg\ q\ V\ r). \rightarrow$ **equivalent**.
$B. ((p \rightarrow q) \rightarrow\ r \equiv\ (p \wedge \neg\ q)\ V\ r).$
$(; p \rightarrow (q \rightarrow\ r) \equiv \neg\ p\ V \neg\ q\ V\ r)$. Not equivalent (counterexample exists). → **not equivalent**.
$C. ((p \rightarrow\ q) \rightarrow (r \rightarrow\ s) \equiv (p \wedge \neg\ q) V \neg\ r\ V\ s).$
$((p \rightarrow\ r) \rightarrow (q \rightarrow\ s) \equiv (p \wedge \neg\ r)\ V \neg\ q\ V\ s).$ Not equivalent $(e.g. (p = F, q = T, r = F, s = F)$ gives different values). → **not equivalent**.
Only A is equivalent.
Answer: (1) A only.

37. Explanation: (1) Both A and R are true and R is the correct explanation of A
Accepting students' current cognitive levels fosters open, effective communication. Moralizing/judging creates barriers, so R explains why A is sound pedagogical practice.
So, Correct option is 1.

38. Explanation: (1)
The statement means:
∃c [Country(c) ∧ Borders(c, India) ∧ Borders(c, Pakistan)].
Check options:
1. ∃c Country(c) ∧ Border(c, India) ∧ Border(c, Pakistan) → Correct meaning (parentheses implied).

2. Uses ⇒ instead of ∧ after Country(c) → Wrong (would be trivial if c not a country).
3. Puts quantifier only on Country(c) ⇒ scope error for c later → Ill-formed.
4. Ill-formed syntax.
   Only option 1 is correct.

39. Explanation: (3)

(A) $\alpha \wedge (\beta \vee \gamma) \equiv (\alpha \wedge \beta) \vee (\alpha \wedge \gamma)$

- This is the distributive law of ∧ over ∨.
- Truth value: True
- Reason: Distributing α across the disjunction $(\beta \vee \gamma)$ yields $(\alpha \wedge \beta) \vee (\alpha \wedge \gamma)$.

(B) $(\alpha \wedge \beta) \equiv \neg\alpha \vee \beta$

- Left side: conjunction $\alpha \wedge \beta$.
- Right side: disjunction with a negation $\neg\alpha \vee \beta$.
- Truth value: False (not equivalent in general)
- Quick check:
  If $\alpha =$ False, $\beta =$ True:
  - Left: False
  - Right: True
  If $\alpha =$ True, $\beta =$ False:
  - Left: False
  - Right: False
  The discrepancy shows they are not equivalent in general.

(C) $\alpha \Rightarrow \beta \equiv \neg\beta \Rightarrow \neg\alpha$

- This is the contrapositive equivalence.
- Truth value: True
- Reason: $p \rightarrow q$ is logically equivalent to $\neg q \rightarrow \neg p$.

(D) $\neg(\alpha \vee \beta) \equiv (\neg\alpha \Rightarrow \neg\beta)$

- By De Morgan: $\neg(\alpha \vee \beta) \equiv \neg\alpha \wedge \neg\beta$.
- The right side is an implication: $\neg\alpha \Rightarrow \neg\beta$, which is equivalent to $\alpha \vee \neg\beta$.
- Truth value: False (not generally equivalent)
- The left side is a conjunction, the right side is an implication.
  Correct answer: 3. (A) and (C) only.

40. Explanation: (1)

Assertion (A): $\bar{P}$ (Not P) is the conclusion.
Reason (R): $(\mathrm{P}_1, \mathrm{P}_2, \mathrm{P}_3, \mathrm{P}_4)$ is the set of premises.
We must check if (R) logically implies (A):
Combine $\mathrm{P}_1, \mathrm{P}_2, \mathrm{P}_3$ to find Q's truth value:

- $r \rightarrow \bar{q}$
- $s \rightarrow \bar{q}$
- $r \vee s$

  By Constructive Dilemma on these three, we conclude $\bar{q} \vee \bar{q}$, which simplifies to $\bar{\mathrm{q}}$. (Not Q)
  Use P_4 with the result from step 1:
- P_4: $p \rightarrow q$
- We know $\bar{q}$.
- The Contrapositive of P_4 is $\bar{q} \rightarrow \bar{p}$.
- By Modus Ponens on $\bar{q}$ and $\bar{q} \rightarrow \bar{p}$, we conclude $\bar{\mathrm{p}}$.

Conclusion:

- The derivation is successful: $\bar{P}$ is a valid conclusion from the premises in (R).
- Assertion (A) ($\bar{P}$) is TRUE (as a valid conclusion).
- Reason (R) (the premises) is TRUE (as the basis for the derivation).
- (R) directly shows the logical steps that *prove* (A), so (R) is the correct explanation of (A).
  Answer: 1. Both (A) and (R) are true and (R) is the correct explanation of (A).

41. Explanation:

- Using '=' instead of '==' to check equality is a logical error because it leads to unintended behavior (assignment instead of comparison).
- Failing to initialize variables before a loop is a logical error because it results in incorrect or unpredictable behavior.
- Using commas instead of semicolons in a for loop header is a syntax error, not a logical error, because it prevents the code from compiling.
- Dividing by zero is a runtime error, not a logical error. This happens when the program encounters a mathematical issue during execution, causing a crash or exception.
  Correct Answer: 2. Divide by zero is NOT a logical error, but a runtime error.

42. Explanation: (1)

Statement I: "Grandparent is a parent of one's parent."

- This statement is true because, by definition, a grandparent is the parent of your parent. If (p) is your parent, then a grandparent is your parent's parent. Hence, Statement I is correct.
  Statement II: The First Order Predicate Logic (FOPL) representation given is:
  $\forall\, g\,, (Grandparent(g, c)$
  $\rightarrow\ Parent(g, p) \wedge\ Parent(p, c))$
- The FOPL representation attempts to express the idea that for any individual (g), if (g) is a grandparent of (c), then (g) is a parent of (p) the parent of (c) and (p) is a parent of (c).
- Grandparent(g, c) indicates (g) is a grandparent of (c).
- Parent(g, p) indicates (g) is a parent of (p).
- Parent(p, c) indicates (p) is a parent of (c).
  This seems to capture the correct logical relationship: a grandparent is a parent of the parent.
  Thus, the correct answer is: 1. Both Statement I and Statement II are correct.

43. Explanation: (2)

Let's carefully analyze the statement:

Original statement: "Some students like hockey."

In logic form: $\exists x$ (Student(x) ∧ LikesHockey(x))

meaning **"There exists at least one student who likes hockey."**

The **negation** of an existential statement (∃) is a universal (∀) statement with negated predicate:

$\neg(\exists x, P(x)) \equiv \forall x \neg P(x)$

So, Negation: $\forall x$ (Student(x) → ¬LikesHockey(x))

which means **"Every student dislikes hockey."**

44. Explanation: (2)

Check each possible guilty person so exactly one statement is false.

If **Q** did it:

A (Q did it) — true.

B (S did it) — false.

C (R didn't do it) — true.

D (Q lied) — true (since B is false).

Exactly one false — works.

Other cases give more than one false statement, so the guilty person must be **Q**.

45. Explanation:

(A) Remainder of 49^{16} when divided by 17

By Fermat's Little Theorem:

If p is prime and a not divisible by p,

$a^{p-1} \equiv 1(mod\ p)$.

Here p=17,a=49.

Since 49≡49-34=15(mod 17),

$15^{16} \equiv 1(mod\ 17)$

So remainder=1

B) Remainder of $2^{446}\ when\ divided\ by\ 9$

Cycle of powers of 2 mod 9:

$2^1 = 2, 2^2 = 4, 2^3 = 8, 2^4 = 7, 2^5 = 5, 2^6 = 1$

Cycle length=6.

Now 446÷6:

$6 \times 74 = 444, remainder\ 2$.

So, $2^{446} \equiv 2^2 \equiv 4(mod\ 9)$.

Remainder=4.

C) Remainder of $155^{17}\ when\ divided\ by\ 17$

By Fermats Theorem:

$a^{17} \equiv a(mod\ 17)$.

Hence remainder= remainder of 155 mod 17.

$17 \times 9 = 153$

$155 - 153 = 2$

So remainder=2

(D) Last digit of 7^{45}

Cycle of last digits of powers of 7:

$7^1 = 7, 7^2 = 9, 7^3 = 3, 7^4 = 1$

Cycle length=4.

Now 45 mod 4=1

Last digit=7

Ascending Order:

1<2<4<7

So,(A),(C),(B),(D)

46. Explanation: (3)

Given: $P(x): x = x^2$

Solve,

$x = x^2 => x^2 - x = 0 => x(x-1) = 0 => x = 0\ or\ x = 1$

So P(x) is true only for x=0 and x=1,false otherwise.

$A)\ P(0): check\ 0 = 0^2 \rightarrow 0 = 0 \rightarrow true$

$B) P(1): check\ 1 = 1^2 \rightarrow 1 = 1 \rightarrow true$

$C) P(2): check\ 2 = 2^2 \rightarrow 2 = 4 \rightarrow true$

$D)\ \exists x\ P(x)$: Means there exists an integer x such that $x = x^2$

True (since x=0 or x=1 works)

E) $\forall x\ P(x): Means\ for\ all\ integers x, x = x^{2\prime}$

False(fails for x=2,etc)

Correct option: (3) (A), (B), and (D) Only

47. Explanation: (4) Let's check each statement over the real numbers.

(A) $\exists x\ \forall y\ (x + y = y)$

Choose (x=0). Then (0+y=y) for all real (y).

→ **True.**

(B) $\forall x\ \forall y\ \Big((x \geq 0) \wedge (y < 0)\Big) \rightarrow (x - y > 0)\Big)$

If $(x \geq 0)\ and\ (y < 0), then\ (x - y = x + |y|)$. $Since\ (|y| > 0), (x - y > 0)$ (even when (x=0)).

→ **True.**

(C) $\exists x\ \exists y\ \Big((x \leq 0) \wedge (y \leq 0)\Big) \wedge (x - y > 0)\Big)$

$Take\ (x = -1, y = -2). Both\ \leq\ 0)\ and\ (x - y = 1 > 0)$.

→ $True$.

(D) $\forall x\ \forall y((x \neq 0) \wedge (y \neq 0) \leftrightarrow (xy \neq 0))$

For real numbers, $(xy = 0)\ iff\ at\ least\ one\ of\ (x, y)\ is\ 0. So\ (xy \neq 0)\ iff\ both\ (x \neq 0)\ and\ (y \neq 0)$.

→ **True.**

All four statements are true.

Answer: (4) (A), (B), (C) and (D) Only.

48. Explanation: (4) Let's check each statement with the universe of integers.

(A) ∀n (n² ≥ 0)

For all integers n, n^2 is always non-negative (0 or positive).

→ True.

(B) ∃n (n² = 2)

Is there an integer n such that $n^2 = 2$?

No, because $\sqrt{2}\ and\ -\sqrt{2}$ are not integers.

→ False.

(C) ∀n (n² ≥ n)

Check if this holds for all integers:

- For n ≥1: yes, $n^2 \geq n$.
- For n ≤ 0:

$-n = 0: 0 \geq 0$
$-n = -1: 1 \geq -1$
$-n = -2: 4 \geq -2$
So yes, it's true for all integers.
→ True.

(D) ∃n ($n^2 < 0$)
Square of any integer is never negative.
→ False.
So true statements: (A) and (C).
Correct option:(4) (A) and (C) Only

49. Explanation:

(A) $P \wedge (P \rightarrow Q)$
$P \rightarrow Q \equiv \neg P \, V Q$
$P \wedge (\neg P \, V Q) \equiv (P \wedge \neg P) V (P \wedge Q)$ => matches(II)

(B) $\neg(P \, V Q) \rightarrow (P \wedge Q)$
¬(P V Q)≡$\neg P \wedge \neg Q$
$(\neg P \wedge \neg Q) \rightarrow (P \wedge Q) \equiv (P \, V Q) V (P \wedge Q) \equiv P \, V Q$ => matches (I)

(C) $P \rightarrow Q$
$\equiv \neg P \, V \, Q \rightarrow matches(III)$

(D) $P \, V \, (Q \wedge R)$
$(P \wedge P) V (P \wedge Q) V (P \wedge R) V (Q \wedge R)$ simplifies to $P \, V (Q \wedge R)$=>matches(IV)

50. Explanation:
Reasoning (universe = integers):

(A) $\forall n \, \forall m \;\; (n^2 < m) - False. e.g. take \; n = 0, m = 0: 0^2 \not< 0^2$

(B) $\exists n \, \forall m \;\; (n < m^2) - True. pick \; n$= -1. $Since \; m^2 \geq 0 \; for \; all \; integers \; m, -1 < m^2 \; holds \; for \; every \; m.$

(C) $\exists n \, \forall m \;\; (n \, m = m) - True. pick \; n$=1 (the multiplicative identity).

(D) $\exists n \, \exists m \;\; (n^2 + m^2 = 6) -$ $False. no \; integer \; squares \; sum \; to \; 6$ $(possible \; squares \; 0,1,4,9, \ldots; \; no \; pair \; gives \; 6)$.

(E) $\exists n \, \exists m \;\; (n + m = 4 \;\wedge\; n - m = 1$— False. solving gives n=2.5, not an integer (so no integer solution).
Thus only (B) and (C) are true.

51. Explanation:

52. Explanation: (3)
We are given the logical expression ($\sim p \wedge \sim q$), where:
- p: "It is a hot day"
- q: "The temperature is $48°C$"

Here:
- ($\sim p$) means "It is not a hot day."
- ($\sim q$) means "The temperature is not $48°C$."

The logical conjunction (∧) means "and." So, ($\sim p \wedge \sim q$) translates to: "It is not a hot day and the temperature is not $48°C$."
Therefore, the correct interpretation is:
"It is neither a hot day nor the temperature is $48°C$."
Thus, the correct answer is (3) It is neither a hot day nor temperature is $48°C$.

53. Explanation: (1) We have to express the statement "Joy is loved by everyone" using quantifiers, where the domain for both (x) and (y) consists of all people in the world.
- $L(x, y)$ is the statement "x loves y."
- The statement "Joy is loved by everyone" means that for every person (x), the person (x) loves Joy.

Using quantifiers, this can be expressed as: $\forall x \, , L(x, Joy)$
This reads as: "For every person (x), (x) loves Joy."
Thus, the correct answer is (1) $\forall x \, L(x, Joy)$.

54. Explanation: (1) We are asked to translate the statement:
$\forall x \, , \exists y \, , (x < y)$
Domain: All real numbers.
- ($\forall x$) → "For all real numbers (x)"
- ($\exists y$) → "there exists a real number (y)"
- ($x < y$) → "such that (x) is less than (y)"

Putting it together in English:
"For all real numbers (x), there exists a real number (y) such that (x) is less than (y)."
Correct answer: (1) For all real numbers x, there exists a real number y such that x is less than y.

55. Explanation: (1) We are asked to evaluate the correctness of the logical equivalences provided. Let's go through each option and assess it:

(A) $\sim (p \wedge q) \equiv \sim p \vee \sim q$
- This is De Morgan's Law. It states that the negation of a conjunction is equivalent to the disjunction of the negations.

$\sim (p \wedge q) \equiv \sim p \vee \sim q$
This is a true equivalence.

(B) $\sim (p \vee q) \equiv \sim p \wedge \sim q$
- This is De Morgan's Law as well. It states that the negation of a disjunction is equivalent to the conjunction of the negations.

$\sim (p \vee q) \equiv \sim p \wedge \sim q$
This is a true equivalence.

(C) $p \wedge \sim p \equiv T$
- The expression ($p \wedge \sim p$) represents a contradiction (it cannot be true because (p) and ($\sim p$) cannot both be true at the same time). Therefore, this is not true. It is equivalent to false (F), not true (T).

(D) $\sim (p \Rightarrow q) \equiv p \wedge \sim q$
- The negation of an implication ($p \Rightarrow q$) is equivalent to ($p \wedge \sim q$).

$\sim (p \Rightarrow q) \equiv p \wedge \sim q$
This is a true equivalence.

(E) $p \vee q \equiv \sim p \vee \sim q$

- This is not true. ($p \vee q$) is not equivalent to ($\sim p \vee \sim q$). The latter represents the negation of a conjunction (by De Morgan's Law), which is not the same as a simple disjunction.

Thus, the correct answer is: (1) (A), (B), and (D) Only.

56. Explanation: (3)

- **Constants (A)**, **Predicates (C)**, and **Functions (E)** are the **non-logical symbols** used to build FOL expressions:
- Constants → terms naming specific objects.
- Function symbols → form new terms from terms.
- Predicate symbols → make atomic formulas from terms.
- **Domain (B)** is **semantic** (the set of objects an interpretation uses), not a symbol in the language.
- **Temporal (D)** refers to **temporal logic** operators (e.g., always, eventually), which are **not part of standard FOL** syntax.

So, Correct option is 3.

57. Explanation: (3)

58. Explanation: (3) Mapping:

- (a) P→¬Q.
- (b) ¬P∧¬Q.
- (c) "It is necessary to be not intelligent in order to be happy" means Q→¬P.
- (d) "To be not intelligent is to be unhappy" means ¬P→¬Q.

So option (3) matches

59. Explanation: (1)

(A) True: if (n≠1) and (n) is a positive integer then (n>1), so (mn>m).
(B) False (nonsensical condition (1<m,n>k) — factors cannot both exceed (k)).
(C) True: for positive integers (mn=1) forces (m=n=1).
(D) True: composite (k) means (k=mn) with (1<m,n<k).

60. Explanation: (3)

A: "If the Indian team wins, then it is raining"
This is a **conditional statement** of the form "If P, then Q" (P → Q).
The **contrapositive** of a conditional statement "If P, then Q" is "If not Q, then not P."
Thus, **A corresponds to III (Contrapositive)**.

B: "If the Indian team does not win, then it is not raining"
This is the **inverse** of the original statement. The inverse of "If P, then Q" is "If not P, then not Q."
Thus, **B corresponds to I (Inverse)**.

C: "If it is raining, then the Indian team wins"
This is the **converse** of the original statement. The converse of "If P, then Q" is "If Q, then P."
Thus, **C corresponds to II (Converse)**.

D: "If it is not raining, then the Indian team does not win"
This is the **contrapositive** of the converse. The contrapositive of "If Q, then P" is "If not P, then not Q."
Thus, **D corresponds to IV (Conditional)**.
So, Correct option is 3.

61. Explanation: (3)

62. Explanation: (2)

- **Referential opacity** means that substituting one term with another having the same reference may change the truth value in certain contexts (e.g., "John believes the morning star is Venus" vs. "John believes the evening star is Venus" — even though both refer to the same planet).
- **Modal logic** (with possible worlds semantics) handles this by evaluating statements in different possible worlds/contexts, keeping references distinct in intensional contexts.
- **First-order/predicate logic** assumes **referential transparency** (substitution of equals preserves truth), so it cannot directly model opacity.

Thus, **Modal logic** is designed for this.
So, Correct option is 2.

63. Explanation: (3)

A. True — For any n, pick $m = n^2 + 1 > n^2$
B. True — Solving $n + m = 4$ and $n - m = 2$ gives $n = 3, m = 1$
C. True — $1^2 + 2^2 = 5$, so $n = 1, m = 2$ works
D. False — One fixed m cannot satisfy $m + n = 0$ for all n
E. True — For any m, pick $n = -m$
So, Correct option is 3.

Unit 1.2: Sets and Relations

Previous Year Exam Questions

(July 2016)

1. How many different equivalence relations with exactly three different equivalence classes are there on a set with five elements ?
(1) 10 (2) 15
(3) 25 (4) 30

(July 2016)

2. Suppose that R_1 and R_2 are reflexive relations on a set A.
Which of the following statements is correct?
(1) $R_1 \cap R_2$ is reflexive and $R_1 \cup R_2$ is irreflexive.
(2) $R_1 \cap R_2$ is irreflexive and $R_1 \cup R_2$ is reflexive.
(3) Both $R_1 \cap R_2$ and $R_1 \cup R_2$ are reflexive.
(4) Both $R_1 \cap R_2$ and $R_1 \cup R_2$ are irreflexive.

(Jan 2017)

3. Consider a sequence F_{00} defined as:

$F_{00}(n) = \frac{10*F_{00}(n-1)+100}{F_{00}(n-2)}$ **for** $n \geq 2$

Then what shall be the set of values of the sequence F_{00}?

(1) (1,110, 1200)
(2) (1, 110, 600, 1200)
(3) (1, 2, 55, 110, 600, 1200)
(4) (1, 55, 110, 600, 1200)

(Jan 2017)

4. The functions mapping R into R are defined as:

$f(x) = x^3 - 4x, g(x) = \frac{1}{x^2+1}$ *and* $h(x) = x^4$.

Then find the value of the following composite functions:

$hog(x)$ **and** $hogof(x)$

(1) $(x^2+1)^4$ and $[(x^2-4x)^2+1]^4$
(2) $(x^2+1)^4$ and $[(x^3-4x)^2+1]^{-4}$
(3) $(x^2+1)^{-4}$ and $[(x^2-4x)^2+1]^4$
(4) $(x^2+1)^{-4}$ and $[(x^3-4x)^2+1]^{-4}$

(July 2018)

5. Which of the relations on {0, 1, 2, 3} is an equivalence relation?

(1) {(0,0) (0, 2) (2, 0) (2, 2) (2, 3) (3, 2) (3, 3)}
(2) {(0,0) (1, 1) (2, 2) (3, 3)}
(3) {(0,0) (0, 1) (0, 2) (1, 0) (1, 1) (1, 2) (2, 0))
(4) {(0,0) (0, 2) (2, 3) (1, 1) (2, 2) }

(July 2018)

6. Which of the following is an equivalence relation on the set of all functions from Z to Z?

(1) $\{(f,g)|f(x)-g(x)=1 \forall x \epsilon Z\}$
(2) $\{(f,g)|F(0)=g(0) or\ f(1)=g(1)\}$
(3) $\{(f,g)|f(0)=g(1) and\ f(1)=g(0)\}$
(4) $\{(f,g)|f(x)-g(x)=k\ for\ some\ k \epsilon Z\}$

(Dec 2018)

7. Match List I with List II and choose the correct answer from the code given below.

List I	List II
(a) Equivalence	(i) p⇒ q
(b) Contrapositive	(II) p ⇒ q:q⇒p
(c) Converse	(iii) p ⇒ q:~q⇒~p
(d) Implication	(iv) p ⇔ q

(1) (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)
(2) (a)-(ii), (b)-(i), (c)-(iii), (d)-(iv)
(3) (a)-(iii), (b)-(iv), (e)-(ii), (d)-(i)
(4) (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)

(June 2019)

8. Consider the poset $(\{3,5,9,15,24,45\},)$.

Which of the following is correct for the given poset?

(1) There exists a greatest element and a least element
(2) There exists a greatest element but not a least element
(3) There exists a least element but not a greatest element
(4) There does not exist a greatest element and a least element.

(Dec 2019)

9. What are the greatest lower bound (GLB) and the least upper bound (LUB) of the sets. $A = \{3,9,12\}$ and $B = \{1,2,4,5,10\}$ if they exist in poset $(z^+,/)$?

(1) $A(GLB-3, LUB-36);\ B(GLB-1, LUB-20)$
(2) $A(GLB-3, LUB-12);\ B(GLB-1, LUB-10)$
(3) $A(GLB-1, LUB-36);\ B(GLB-2, LUB-20)$
(4) $A(GLB-1, LUB-12);\ B(GLB-2, LUB-10)$

(Dec 2019)

10. Let P be the set of all people. Let R be a binary relation on P such that (a,b) is in R if a is a brother of b .Is R symmetric transitive, an equivalence relation, a partial order relation?

(1) NO, NO, NO, NO (2) NO, NO, YES, NO
(3) NO, YES, NO, NO (4) NO, YES, YES, NO

(Dec 2019)

11. How many reflexive relations are there on a set with 4 elements?

(1) 2^4 (2) 2^{12}
(3) 4^2 (4) 2

(June 2020)

12. Consider the following properties:

A. Reflexive
B. Antisymmetric
C. Symmetric

Let $A = \{a,b,c,d,e,f,g)$ and $R = ((a,a),(b,b),(c,d),(c.g),(d,g),(e.e).(f.f),(g.g)\}$ be a relation on A. Which of the following property (properties) is (are) satisfied by the relation R?

(1) Only A (2) Only C
(3) Both A and B (4) B and not A

(June 2020)

13. Match List I with List II

Let R_1 = {(1,1), (2,2), (3,3)) and R_2 = {(1,1), (1,2), (1,3), (1,4)}

(A) $R^1 \cup R_2$	(I) $\{(1.1).(1.2).(1.3).(1.4).(2.2).(3.3)\}$
(B) $R_1 - R_2$	(ii) $\{(1,1))$
(C) $R_1 \cap R_2$	(III) $(1.2).(1.3).(1.4)\}$
(D) $R_2 - R1$	(iv) $\{(2,2),(3,3)\}$

Choose the correct answer from the options given below:

(1) A-I, B-II, C-IV, D-III (2) AI, B-IV, C-III, D-II
(3) A-I, B-III, C-II, D-IV (4) A-I, B-IV, C-II, D-III

(June 2021)

14. Which of these statements about the floor and ceiling functions are correct?

Statement I: $\lfloor 2x \rfloor = \lfloor x \rfloor + \left\lfloor x + \left(\frac{1}{2}\right) \right\rfloor$ for all real number x