

PART – A

- a, b, c are three consecutive integers. If $c^2 - a^2 = 100$, then,
(A) a, b, c are all composite numbers
(B) a, c are twin primes
(C) b is a prime number
(D) None of the above
- In the multiplication,
 $ON \times ON = MOON$
each letter stands for a unique digit from '0' to '9'. What is 'O' ?
(A) 4 (B) 5 (C) 5 (D) 7

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- A die has three '1's, two '2's and one '5' on its six faces. What is the mean value of the numbers obtained if the die is thrown a larger number of times ?
(A) 3.5 (B) 3 (C) 2 (D) 1.5
- 48 coins are divided into three unequal heaps. If as many coins are taken from the first heap and added to the second heap and as many there are in the third are taken from the second and added to the third heap, and as many there are in the first are taken from the third and added to the first, all the heaps would be having equal number of coins. How many were there in each heap originally ?
(A) 20, 18, 12 (B) 22, 14, 12 (C) 20, 28, 10 (D) 18, 22, 8

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- An eight-toothed wheel is coupled with a 24-toothed wheel. How many times will the small wheel rotate on its axis to circle around the bit wheel ?
(A) 2 (B) 3 (C) 4 (D) 6



6. Two workers X and Y living in the same house and working in the same office reach the office in 30 minutes and 20 minutes respectively. If Y starts 5 minutes later than X, when would be catch up X ?
(A) in 10 minutes (B) in 12 minutes
(C) in 8 minutes (D) None of the above
7. 40 cows can eat grass in a field in 40 days and 30 cows can eat the grass in 60 days. In how many days can 20 cows eat all the grass in the field ?
(A) 60 (B) 80 (C) 120 (D) 150

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8. There are five books A, B, C, D and E placed on a table. If A is placed below E, C is placed above D, B is placed below A and D is placed above E, then which of the following books touches the surface of the table ?
(A) C (B) B (C) A (D) E
9. The hour and minute hands of a clock meet 65 minutes. As compared to a normal clock that keeps correct time, this clock
(A) gains 5 minutes every 11 hours
(B) loses 5 minutes every 11 hours
(C) gains 11 minutes every 5 hours
(D) loses 11 minutes every 5 hours

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10. If FRIEND is coded as HUMJTK; CANDLE is coded as
(A) DEQJQM (B) EDRIRL (C) DCQHOK (D) ESJFME
11. If A is the son of Q, Q and Y are sister, Z is the mother of Y, P is the son of Z, then which of the following statement is correct ?
(A) F is the maternal uncle of A (B) P and Y are sisters
(C) A and P are cousins (D) Q is the mother of Z



12. You are taking a multiple choice test for which you have mastered 70% of the course material. Assume this means that you have a 0.7 chance of knowing the answer to a random test question, and that if you don't know the answer to a question then you randomly select among the four answer choices. Assume that all choices are uniformly distributed. If there are 50 questions in total, what is your expected score (as a percent) on the exam ?
- (A) 70 (B) 75 (C) 77.5 (D) 82.5
13. Three ladies X, Y and Z marry three men A, B and C. X is married to A, Y is not married to an engineer, Z is not married to a doctor, C is not a doctor and A is a lawyer. Then which of the following statements is correct ?
- (A) y is married to C who is an engineer
(B) Z is married to C who is a doctor
(C) X is married to a doctor
(D) None of the above

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14. In the current western calendar system, which of the following years' calendar will be repeat of this year's (i.e. all the weekdays match) ? E.g. if 2/6/17 is a Friday, then 2 June in that year will also be a Friday.
- (A) 2023 (B) 2025 (C) 2030 (D) 2036
15. If $\sqrt{ATOM} = A + TO + M$, what is 'TO' ? Each letter stands uniquely for a digit between 0 and 9.
- (A) 20 (B) 29 (C) 36 (D) 52

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16. A physicist, who is in a hurry, walks up an upward moving escalator at the rate of one step per second, 20 steps bring him to the top. Next, day, he goes at two steps per seconds reaching the top in 32 steps. How many steps are there in the escalator
- (A) 40 (B) 80 (C) 120 (D) 140



17. A's age is the sum of B's age and the cube roots of C's age. B's age is the sum of C's age, cube root of A's age plus 14. C's age is the sum of cube root of the A's age and square root of B's age. What is B's age ?
(A) 27 years (B) 49 years (C) 64 years (D) 81 years
18. Karim and Kausar have only one camel to ride between them. Karim rides the camel for sometimes, then ties it to a shrub for Kausar and then continues on the journey by walk. When Kausar reaches and camel, she rides the camel for sometimes and then ties it to any convenient object and proceeds by walk. They proceed this way alternately walking and riding. If they walk at 4 kmph and ride at 12 kmph, for what part of the times of the journey is the camel resting ?
(A) one fourth of the time (B) one third of the time
(C) half of the time (D) sixty percent of the time

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19. Two trains one – one travelling from station A to Station B, and the other from Station B to Station A – leave their respective stations at the same time. The first arrives at its destination 1 hr after the two trains meet and the second reaches they meet. Which of the following statement is true ?
(A) The first train is twice as fast as the second
(B) The first train is 1.5 times faster than the second
(C) The first train is 2.25 times faster than the second
(D) None of the above

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20. Two people were going from Town A to Town B. After sometimes, one asked the other, "How much have we travelled?" and the other answered, "half the distance yet to go." After another 2 Km, the first asked the second traveler. "How much further do we have to go?" and the second answered, "half the distance we already travelled." What is the distance between A and B ?
(A) 8 Km (B) 12 Km (C) 6 KM (D) 10 km

21. Two ships of equal length t are moving in opposite directions with speeds u and v kmph respectively. If a takes them t second to cross each other, then (in meters) is
- (A) $\frac{18}{5}(u+v)t$ (B) $\frac{5t(u+v)}{36}$
 (C) $\frac{5t(u+v)}{18}$ (D) None of these above
22. A pack of playing cards is separated into Red and Black colours and then put into three piles.
 Pile 1 : contains three times as many blacks as reds.
 Pile 2 : Contains three times as many reds as blacks.
 Pile 3 : Contains twice as many blacks as reds.
 How many Red and Black cards are there in each pile ?
- (A) Pile 1 : 12 black, 4 reds, Pile 2 : 6 black, 18 reds, Pile 3 : 8 blacks, 4 reds
 (B) Pile 1 : 6 black, 2 reds, Pile 2 : 8 black, 24 reds, Pile 3 : 4 blacks, 2 reds
 (C) Pile 1 : 18 black, 6 reds, Pile 2 : 5 black, 15 reds, Pile 3 : 4 blacks, 2 reds
 (D) None of the above

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23. A mathematician observed the four digits number portion of the licence plate of speeding car. He said that the first three digits formed a perfect square and so did the last three digits. In fact, he said, quite happily, "if you reverse the order of the first three digits, you get the last three". What is the square root of the last three digits ?
- (A) 11 (B) 12 (C) 21 (D) 31
24. If is found that the perimeter of a right, angled triangle is numerically equal to its area. What is more, it is an integer value. Then, hypotenuse of the triangle is
- (A) 36 units (B) $\sqrt{18}$ units (C) 13 units (D) 5 units

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25. Ram was 3 times as old as his sister maya 2 years ago and 5 times as old 2 years before that. In how many years will the ratio of their ages be 2 : 1 ?
- (A) 1 (B) 2 (C) 4 (D) 8

PART – B

26. Let f, g be functions that map $\mathbb{R} \rightarrow \mathbb{R}$ and let function $h = f \circ g$. which of the following is not true about $h(x)$ when $f(x) = \exp(-x)$ and $g(x) = x^2$?
- (A) h is uniformly continuous
(B) definite integral of h for a, b ($b > a$) exists for all real numbers a, b
(C) integral of h has a closed form
(D) Function h is differentiable everywhere
27. The derivative of $f(x) = \exp(-|x|)$ at $x = 0$ is
- (A) $\exp(-|x|)$ (B) $\exp(-x)$
(C) $-\exp(-|x|)$ (D) Derivative does not exist

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28. Consider the functions

$$f(x) = \exp(-x)$$

$$h(x) = \exp(-x^2)$$

$$u(x) = \cos(x)$$

$$w(x) = |x^3|$$

which of the following is true when x is a real number ?

- (A) All the function f, h, u, w are even functions
(B) Only u is an even function
(C) Only f is an even function
(D) Only w an even function

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29. Let $f(x) = \exp(-x)$ and $u(x) = \cos(x)$, then the left derivative of u and the right derivative of f at $x = 0$ are
- (A) equal to -1 (B) equal to 0 (C) 0 and -1 (D) 1 and 0



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30. If A and B are symmetric matrices of the same order, then $AB - BA$ is a
- (A) Skew symmetric matrix
 - (B) Symmetric matrix
 - (C) Zero matrix
 - (D) Identity matrix
31. If a matrix A is both symmetric and skew symmetric, then A is a
- (A) Diagonal matrix
 - (B) Zero matrix
 - (C) Square matrix
 - (D) None of the above

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32. If a, b, c are in Arithmetic Progression, then the determinant $\begin{vmatrix} x+2 & x+3 & x+2a \\ x+3 & x+4 & x+2b \\ x+4 & x+5 & x+2c \end{vmatrix} =$
- (A) 0
 - (B) 1
 - (C) x
 - (D) 2x
33. Let A be a square matrix of order 3×3 . If $| \cdot |$ indicates determinant, then $|kA| =$
- (A) $k|A|$
 - (B) $k^2|A|$
 - (C) $k^3|A|$
 - (D) $3k|A|$

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34. If a, B are two events such that $P(A) \neq 0$ and $P(B|A) = 1$, then
- (A) $A = \phi$
 - (B) $B = \phi$
 - (C) $B \subseteq A$
 - (D) $A \subseteq B$
35. A subset B of items is removed from a set of items A and added to another set of items C. If, as a result, the mean value of the items in both sets A and C increases, then
- (A) $\mu_A < \mu_B < \mu_C$
 - (B) $\mu_C < \mu_B < \mu_A$
 - (C) $\mu_C < \mu_A < \mu_B$
 - (D) None of the above
- ($\mu_A < \mu_B$ and μ_C are the original mean values of items in A, B and C respectively)

36. If $\omega \neq 1$ is a complex cube root of unity and $H = \begin{bmatrix} \omega & 0 \\ 0 & \omega \end{bmatrix}$ then $H^{2017} =$
- (A) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ (B) $\begin{bmatrix} \omega & 0 \\ 0 & \omega \end{bmatrix}$ (C) $\begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}$ (D) zero matrix
37. At $x = \frac{1}{6}$, what is the value of $\frac{d^4}{dx^4}(3x^2 - x)$
- (A) 0 (B) $-\frac{1}{6}$ (C) $\frac{1}{18}$ (D) 6

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38. In a triangle ΔABC with $\angle C = \frac{\pi}{2}$. If $\tan \frac{A}{2}$ and $\tan \frac{B}{2}$ are roots of the equation $ax^2 + bx + c = 0$, $a \neq 0$, then
- (A) $a = b + c$ (B) $b = a + c$ (C) $c = a + b$ (D) $a = b = c$

39. If $A = \begin{bmatrix} 5 & 5\alpha & \alpha \\ 0 & \alpha & 5\alpha \\ 0 & 0 & 5 \end{bmatrix}$ and $\det(A^2) = 25$, then
- (A) $|\alpha| = 5$ (B) $\alpha = \sqrt{5}$ (C) $\alpha = \sqrt[5]{25}$ (D) $|\alpha| = \frac{1}{5}$

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40. $\int_5^8 \frac{\log x^4}{\log x^2 + \log(13-x)^2} dx =$
- (A) 3 (B) $\frac{3}{2}$ (C) 1 (D) $\frac{1}{3}$

41. A bag contains four balls. One is blue, one is white and two are red. Two balls at random are drawn from the bag. If there is a red balls among the two balls drawn out, what is the probability that the other ball drawn out is also red ?

- (A) $\frac{1}{15}$ (B) $\frac{1}{10}$
(C) $\frac{1}{5}$ (D) None of the above

42. Let $\cos(\alpha + \beta) = \frac{4}{5}$ and $\sin(\alpha - \beta) = \frac{5}{13}$, $\theta \leq \alpha, \beta \leq \frac{\pi}{4}$, then $\tan 2\alpha =$

- (A) $\frac{50}{33}$ (B) $\frac{19}{12}$ (C) $\frac{20}{7}$ (D) $\frac{25}{16}$

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43. Consider the following statements :

$$S : \cos(A) + \cos(B) + \cos(C) = 0$$

$$T : \sin(A) + \sin(B) + \sin(C) = 0$$

If

$$\cos(B - C) + \cos(C - A) + \cos(A - B) = -\frac{3}{2}$$

Then

- (A) S is true, but T is false (B) S is false, but T is true
(C) both S and T are true (D) both S and T are false

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44. If $\sin^{-1} \frac{x}{5} + \operatorname{cosec}^{-1} \frac{5}{4} = \frac{\pi}{2}$, then $x =$

- (A) 1 (B) 3 (C) 5 (D) 7

45. If $\cot^{-1}[(\cos\alpha)^{1/2}] + \tan^{-1}[(\cos a)^{1/2}] = x$, then $\sin(x) =$
 (A) 1 (B) $\cot^2\left(\frac{\alpha}{2}\right)$ (C) $\tan \alpha$ (D) $\cot\left(\frac{\alpha}{2}\right)$
46. In the IEEE754 floating point format, a 64-bit floating point number has a significand of
 (A) 48 bits (B) 53 bits (C) 54 bits (D) 58 bits

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47. The graph of $f(x)$ intersects any line of the form $y = k$, $|k| \leq 100$ only once, then $f(x)$ is
 (A) One-to-One function
 (B) Onto function
 (C) One-to-One and Onto function
 (D) Not a function
48. The least negative value that the product of two 8-bit signed 2's complement numbers can have is
 (A) -2^{16} (B) -2^{15} (C) -2^{14} (D) -2^{12}

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49. Number of bytes used for representation of ASCII character in Unicode Transformation Format (UTF-8) is
 (A) 1 (B) 2 (C) 3 (D) 4
50. Consider the following system of equations

$$kx + y - z = 0$$

$$-x + ky + z = 0$$

$$x + ky + z = 0$$

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

51. Let $f(x) = (x - 2)(8 - x)$, $2 \leq x \leq 8$. Find $f(f(3))$ and $f(f(5))$.
 (A) 5 and 9 (B) 9 and 5
 (C) 9 and not defined (D) not defined and not defined
52. In a class of 100 students, as least 90 are good at Physics; at least 80 are good at Maths; and at least 70 are good at Chemistry. At least how many students are good at all three ?
 (A) 30 (B) 40 (C) 60 (D) 70

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53. If $4\sin^{-1}x + \cos^{-1}x = \pi$, then $x =$
 (A) 1 (B) $\pi/2$ (C) $1/2$ (D) $\pi/6$

54. The range of

$$f(x) = \frac{x^2}{x^4 + 1}, x \in \mathbb{R} \text{ is}$$

- (A) $[0, 2]$ (B) $\left[0, \frac{1}{2}\right]$ (C) $(0, \infty)$ (D) $\left(0, \frac{1}{2}\right)$

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55. Let $f(x) = [\tan^2 x]$, where $[\cdot]$ indicates the greatest integer smaller than \cdot function, then

- (A) $\lim_{x \rightarrow 0} f(x)$ does not exist (B) $f(x)$ is continuous at 0
 (C) $f(x)$ is not differentiable at $x = 0$ (D) $f'(0) = 1$

56. Let $f(x) = \begin{cases} |x-1| + x & \text{if } x \leq 1 \\ 2x+3, & \text{if } x > 1 \end{cases}$

If $f(x)$ has a local minimum at $x = 1$, then $a \leq$

- (A) 5 (B) -1 (C) 0 (D) -5



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57. Convert the following octal number to binary : 104_8
(A) 01000100 (B) 01101000 (C) 00100100 (D) 01000001
58. The 10's complement of 715_8 is
(A) 63 (B) 285 (C) 395 (D) 539
59. Which of the following decimal numbers when represented in binary has the smallest number of '1' s ?
(A) 63 (B) 224 (C) 1020 (D) 2079

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60. A computer with 32-bit word size uses 2's complement representation for integers. The range of integers that can be represented on this computer is
(A) -2^{31} to 2^{31} (B) $-2^{32} - 1$ to 2^{32}
(C) -2^{31} to $2^{31} - 1$ (D) -2^{32} to 2^{31}
61. Someone claims to have found a long lost work by Mr. Khuswant Singh. She asks you to decide whether or not the book was actually written by Mr. Khuswant. Based on the assumption that all his books have similar word frequencies. You buy a copy of "Train of Pakistan" (B1) written by Mr. Khuswant and count the frequencies of certain common words on some randomly selected pages. You do the same thing for the 'long lost work' (B2). When you perform the test, you get a score of 78.93. For 3 degrees of freedom, Chi-Square value for 0.01 significance level is 6.25. What do you conclude about 'long lost work'?
(A) Written to Mr. Khuswant Singh (B) Not Written to Mr. Khuswant Singh
(C) Not enough information (D) Chi-square test cannot be used

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62. A person gets three chances to throw a '4' and win a game. The probability of winning on the third throw, assuming a fair die, is
(A) $\frac{5}{36}$ (B) $\frac{25}{216}$ (C) $\frac{25}{36}$ (D) $\frac{125}{216}$

63. Area of the region bounded by the curve $y = e^x$ and lines $x = 0$ and $y = e$ is

- (A) $\int_1^e \ln(e+1-y)dy$ (B) $e - \int_0^1 e^x dx$
 (C) $\int_1^e \ln(y)dy$ (D) All of the above

64. Suppose a nonhomogeneous system of 15 linear equations in 17 unknowns has a solution for all possible constants on the right side of the equation. Then, the associated system of homogeneous linear equations

- (A) has at most 1 linearly independent solution
 (B) has at most 1 linearly independent solutions
 (C) has at most 3 linearly independent solutions
 (D) None of the above

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65. Given a set of $2n + 1$, ($n > 10$) sample measurements of a random variable X ,

- (A) Their mean is always one of the measured values
 (B) Their median is always one of the measured values
 (C) Their median is always smaller than the mean
 (D) None of the above

66. If $\hat{a}, \hat{b}, \hat{c}, \hat{d}$ are unit vectors such that $(\hat{a} \times \hat{b}) \cdot (\hat{c} \times \hat{d}) = 1$ and $\hat{a} \cdot \hat{c} = \frac{1}{2}$, then

- (A) $\hat{a}, \hat{b}, \hat{c}$ are non-coplanar
 (B) $\hat{b}, \hat{c}, \hat{d}$ are non-coplanar
 (C) \hat{b}, \hat{d} are non-parallel
 (D) \hat{a}, \hat{d} are parallel and \hat{b}, \hat{c} are parallel

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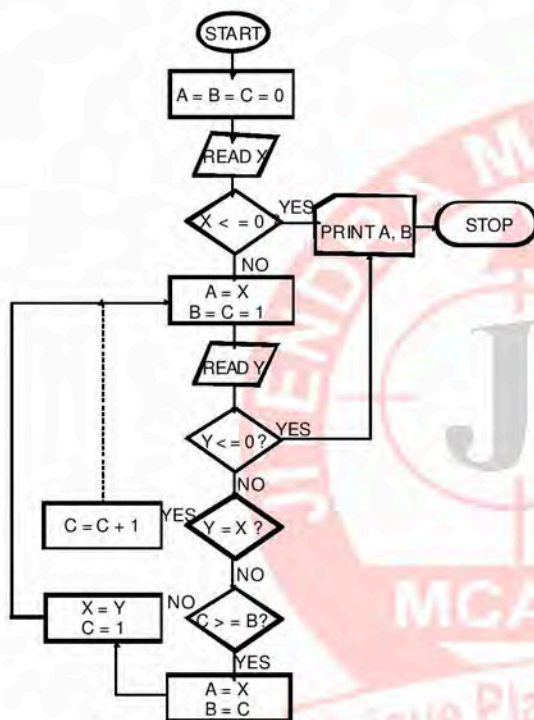
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67. The mean value of the marks of 90 students in a class was calculated as 32. Later it was found that a student's marks of 61 was misread as 81. What is the correct mean?
 (A) 32, 78 (B) 31, 78 (C) 32, 22 (D) 31, 22
68. If ${}^n C_{r-1} = 36$; ${}^n C_r = 84$; ${}^n C_{r+1} = 126$, then $r =$
 (A) 9 (B) 6 (C) 5 (D) 3
69. Which of the following is a measure of the relative peakedness or flatness of frequency distribution curve ?
 (A) Skewness (B) Standard Deviation
 (C) Kurtosis (D) Median

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Questions 70 – 72 are based on the flow-chart given below.



70. Given the input 1 1 3 3 5 7 7 9 11 0, what is output B ?
 (A) 0 (B) 1 (C) 3 (D) 7

71. If the input contains only one value V repeated N times, what are the outputs A and B ?
- (A) $A = B, B = N$ (B) $A = 0, B = 1$
(C) $A = 0, B = N$ (D) None of the above
72. What computation is represented in the flow-chart ?
- (A) Calculate Frequencies (B) Calculate Mode
(C) Calculate maximum (D) Calculate Minimum

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73. A teacher wrote an equation $ax^2 + bx + c = 0$ on the blackboard and asked the student to solve it. A careless student made a small mistake in copying and found out that he got the same roots (α, β) as the rest but with opposite signs. What was his mistake ?
- (A) Changed the sign of c (B) Changed the sign of b
(C) Interchanged b and c (D) Interchanged a and b
74. Let $X = \{1, 2, 3, \dots\}$ and let R be a relation on $X \times X$ such that $(x, y) R(u, v)$ if $xu = yv$. Then R is
- (A) Reflexive and Symmetric but not Transitive
(B) Reflexive and Transitive but not Symmetric
(C) an Equivalence relation
(D) None of the above

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75. Let A, B, C be subsets of the universal set U . Let $A \cap B = A \cap C$ and $\bar{A} \cap \bar{B} = \bar{A} \cap \bar{C}$. Then,
- (A) $B = C$ (B) $A = C$
(C) $A = B = C$ (D) None of the above