Linear Programming

2. Let m = (313)4 and n = (322)4. Find the base 4 expansion of m + n.

(1) (635)4

(2) (32312)4

(3) (21323)4

(4) (1301)4

Answer: 4

Explanation:

m = (313)4 and n = (322)4

Convert m and n to decimal.

m = 3*4^2 + 1*4^1 + 3*4^0 = 48+4+3 = (55)10

m = 3*4^2 + 2*4^1 + 2*4^0 = 48+8+2 = (58)10

m+n = 55+58 = 113

Now we have to convert 113 to base 4.

113%4 = 1 ---(1)

113/4 = 28

28%4 = 0 ---(2)

28/4 = 7

7%4 = 3 ----(3)

7/4 = 1

1%4 = 1 ----(4)

The answer will be step (4) to step (1) = 1301

4. How many multiples of 6 are there between the following pairs of numbers?

0 and 100 and -6 and 34

(1) 16 and 6

(2) 17 and 6

(3) 17 and 7

(4) 16 and 7

Answer: 3

Explanation:

Number of multiples of 6 between 1 and 100 = 100/6 = 16

Since the range starts from zero, we need to take zero too. [zero is a multiple of every integer (except zero itself)].

So, answer = 16+1 = 17

Number of multiples of 6 between 1 and 34 = 34/6 = 5
Since the range is -6 to 34, we need to take -6 and zero.

So, answer = 5+2 = 7

48. How many solutions are there for the equation x+y+z+u=29 subject to the constraints that $x \geq 1$, $y \geq 2$, $z \geq 3$ and $u \geq 0$?
(A) 4960 (B) 2600
(C) 23751 (D) 8855
Answer: B
Explanation:
We let $y_1=x-1$, $y_2=y-2$, $y_3=z-3$, $y_4=u-0$
We count the number of solutions for $y_1+y_2+y_3+y_4=29-6=23$
n=4, r=23
The number of solutions is C(n+r-1, r) = C(4+23-1, 23)
= C(26,23) = C(26,3) = 26x25x24/1x2x3 = 2600

1. How many strings of 5 digits have the property that the sum of their digits is 7 ?
(A) 66 (B) 330
(C) 495 (D) 99
Answer: B

1. 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) 4 O'clock

Answer: 1

Explanation:

After 24 hours, time will again be 4 O'clock.

101%24 = 5

Hence time after 101 hours will be 4+5=9 o'clock

70. Consider the following LPP:
Min. $Z = x_1+x_2+x_3$
Subject to $3x_1 + 4x_3 \leq 5$
$5x_1 + x_2 + 6x_3 = 7$
$8x_1 + 9x_3 \geq 2$
$x_1, x_2, x_3 \geq 0$
The standard form of this LPP shall be:
(1) Min. $Z = x_1 + x_2 + x_3 + 0x_4 + 0x_5$
Subject to $3x_1 + 4x_3 + x_4 = 5$;
$5x_1 + x_2 + 6x_3 = 7$;
$8x_1 + 9x_3 - x_5 = 2$;
$x_1, x_2, x_3, x_4, x_5 \geq 0$
(2) Min. $Z = x_1 + x_2 + x_3 + 0x_4 + 0x_5 -1(x_6)-1(x_7)$
Subject to $3x_1 + 4x_3 + x_4 = 5$;
$5x_1 + x_2 + 6x_3 +x_6 = 7$;

$8x_1 + 9x_3 - x_5 + x_7 = 2;$
x_1 to $x_7 \geq 0$
(3) Min. $Z = x_1 + x_2 + x_3 + 0x_4 + 0x_5 + 0x_6$
Subject to $3x_1 + 4x_3 + x_4 = 5;$
$5x_1 + x_2 + 6x_3 = 7;$
$8x_1 + 9x_3 - x_5 + x_6 = 2;$
x_1 to $x_6 \geq 0$
(4) Min. $Z = x_1 + x_2 + x_3 + 0x_4 + 0x_5 + 0x_6 + 0x_7$
Subject to $3x_1 + 4x_3 + x_4 = 5;$
$5x_1 + x_2 + 6x_3 + x_6 = 7;$
$8x_1 + 9x_3 - x_5 + x_7 = 2;$
x_1 to $x_7 \geq 0$
Answer: 1

61. Consider the following linear programming problem:
Max. $z = 0.50x_2 – 0.10x_1$
Subject to the constraints
$2x_1 + 5x_2 \leq 80$
$x_1 + x_2 \leq 20$
and $x_1, x_2 \geq 0$
The total maximum profit (z) for the above problem is:
(A) 6 (B) 8
(C) 10 (D) 12
Answer: B

63. The following transportation problem:

	A	B	C	Supply
I	50	30	220	1
II	90	45	170	3
III	250	200	50	4
Demand	4	2	2	

has a solution

	A	B	C
I	1		
II	3	0	
III		2	2

The above solution of a given transportation problem is
(A) infeasible solution (B) optimum solution
(C) non-optimum solution (D) unbounded solution
Answer: B

61. The region of feasible solution of a linear programming problem has a .... property in geometry, provided the feasible solution of the problem exists.
(A) concavity (B) convexity
(C) quadratic (D) polyhedron
Answer: B

52. A basic feasible solution of a linear programming problem is said to be .... if at least one of the basic variable is zero.
(A) degenerate (B) non-degenerate
(C) infeasible (D) unbounded
Answer: A

53. Consider the following conditions :

(a) The solution must be feasible, i.e. it must satisfy all the supply and demand constraints.
(b) The number of positive allocations must be equal to m+n-1, where m is the number of rows and n is the number of columns.
(c) All the positive allocations must be in independent positions.
The initial solution of a transportation problem is said to be non-degenerate basic feasible solution if it satisfies :

Codes :
(A) (a) and (b) only (B) (a) and (c) only
(C) (b) and (c) only (D) (a), (b) and (c)
Answer: D

54. Consider the following transportation problem :

	Stores					
		I	II	III	IV	Supply
Factories	A	4	6	8	13	50
	B	13	11	10	8	70
	C	14	4	10	13	30
	D	9	11	13	8	50
	Demand	25	35	105	20	

The transportation cost in the initial basic feasible solution of the above transportation problem using Vogel's Approximation method is :
(A) 1450 (B) 1465
(C) 1480 (D) 1520
Answer: B

68. Consider the following transportation problem:

→ Warehouse

↓ Factory		W_1	W_2	W_3	Supply
	F_1	16	20	12	200
	F_2	14	8	18	160
	F_3	26	24	16	90
	Demand	180	120	150	

The initial basic feasible solution of the above transportation problem using Vogel's Approximation Method(VAM) is given below:

→ Warehouse

↓ Factory		W_1	W_2	W_3	Supply
	F_1	16 (140)	20	12 (60)	200
	F_2	14 (40)	8 (120)	18	160
	F_3	26	24	16 (90)	90
	Demand	180	120	150	

The solution of the above problem:
(A) is degenerate solution (B) is optimum solution
(C) needs to improve (D) is infeasible solution
Answer: B

69. Given the following statements with respect to linear programming problem:
S_1: The dual of the dual linear programming problem is again the primal problem
S_2: If either the primal or the dual problem has an unbounded objective function value, the other problem has no feasible solution
S_3: If either the primal or dual problem has a finite optimal solution, the other one also possesses the same, and the optimal value of the objective functions of the two problems are equal.

Which of the following is true?
(A) S_1 and S_2 (B) S_1 and S_3
(B) S_2 and S_3 (D) S_1, S_2 and S_2
Answer: D

70. Consider the two class classification task that consists of the following points:
Class C_1: [1 1.5] [1 -1.5]
Class C_2: [-2 2.5] [-2 -2.5]
The decision boundary between the two classes using single perceptron is given by:
(A) $x_1+x_2+1.5=0$ (B) $x_1+x_2-1.5=0$
(C) $x_1+1.5=0$ (D) $x_1-1.5=0$
Answer: C

68. The occurrence of degeneracy while solving a transportation problem means that
(A) total supply equals total demand
(B) total supply does not equal total demand
(C) the solution so obtained is not feasible
(D) none of these
Answer: C

67. If an artificial variable is present in the 'basic variable' column of optimal simplex table, then the solution is
(A) Optimum (B) Infeasible
(C) Unbounded (D) Degenerate
Answer: B

60. The initial basic feasible solution of the following transportion problem :

		Destination			
		D_1	D_2	D_3	Supply
	O_1	2	7	4	5
Origins	O_2	3	3	1	8
	O_3	5	4	7	7
	O_4	1	6	2	14
Demand		7	9	18	

is given as

5		
		8
	7	
2	2	10

then the minimum cost is
(A) 76
(B) 78
(C) 80
(D) 82
Answer: A

58. Which of the following special cases does not require reformulation of the problem in order to obtain a solution?
(A) Alternate optimality
(B) Infeasibility
(C) Unboundedness

(D) All of the above

Answer: A

1. If the primal Linear Programming problem has unbounded solution, then it's dual problem will have

(A) feasible solution

(B) alternative solution

(C) no feasible solution at all

(D) no bounded solution at all

Answer: C

Explanation:

Unboundedness Property: If the primal (dual) problem has an unbounded solution, then the dual (primal) problem is infeasible

2. Given the problem to maximize f(x), $X=(x_1,x_2,...x_n)$ subject to m number of inequality constraints.

$g_i(x) \leq b_i$, i=1,2.....,m

including the non-negativity constraints $x \geq 0$.

Which one of the following conditions is a Kuhn-Tucker necessary condition for a local maxima at x' ?

(A) $\partial L(X', \lambda', S')/\partial x_j = 0$, j = 1, 2,...m

(B) $\lambda_i'[g_i(X')-b_i] = 0$, i = 1, 2,...m

(C) $g_i(X') \leq b_i$, i = 1, 2...m

(D) All of these

Answer: D

3. The following Linear Programming problem has:

Max $Z = x_1+x_2$

Subject to $x_1-x_2 \geq 0$

$3x_1-x_2 \leq -3$

and $x_1, x_2 \geq 0$

(A) Feasible solution

(B) No feasible solution

(C) Unbounded solution

(D) Single point as solution

Answer: B

13. If an artificial variable is present in the 'basic variable' of optimal simplex table then the solution is ....

(A) Alternative solution

(B) Infeasible solution

(C) Unbounded solution

(D) Degenerate solution

Answer: B

14. An optimal assignment requires that the minimum number of horizontal and vertical lines that can be drawn to cover all zeros be equal to the number of
    (A) rows or columns
    (B) rows + columns
    (C) rows + columns – 1
    (D) rows + columns + 1
    Answer: A
15. Which of the following is the minimum cost for an assignment problem given below?

Jobs

		A	B	C	D
Workers	I	5	3	2	8
	II	7	9	2	6
	III	6	4	5	7
	IV	5	7	7	8

(A) 13 (B) 16
(C) 17 (D) 18

Answer: C
18. In a Linear Programming Problem, suppose there are 3 basic variables and 2 non-basic variables, then the possible number of basic solutions are
    (A) 6
    (B) 8
    (C) 10
    (D) 12
    Answer: C
    Explanation:
    Number of basic solutions are
    $^nC_m = {}^5C_3 = {}^5C_2 = 5x4/1x2 = 10$
62. Consider the following statements:
    (a) Revised simplex method requires lesser computations than the simplex method.
    (b) Revised simplex method automatically generates the inverse of the current basis matrix.
    (c) Less number of entries are needed in each table of revised simplex method than usual simplex method.
    Which of these statements are correct?
    (A) (a) and (b) only (B) (a) and (c) only
    (C) (b) and (c) only (D) (a), (b) and (c)
    Answer: D
68. With respect to a loop in the transportation table, which one of the following is not correct?
    (1) Every loop has an odd no. of cells and at least 5.
    (2) Closed loops may or may not b square in shape.
    (3) All the cells in the loop that have a plus or minus sign, except the starting cell, must be occupied cells.
    (4) Every loop has an even no. of cells and at least four.
    Answer: 1
69. At which of the following stage(s), the degeneracy do not occur in transportation problem?
    (m, n represents number of sources and destinations respectively)
    (a) While the values of dual variables u_i and v_j cannot be computed.
    (b) While obtaining an initial solution, we may have less than m + n -1 allocations.
    (c) At any stage while moving towards optimal solution, when two or more occupied cells with the same minimum allocation become unoccupied simultaneously.
    (d) At a stage when the no. of +ve allocation is exactly m + n - 1.
    (1) (a), (b) and (c)
    (2) (a), (c) and (d)

(3) (a) and (d)
(4) (a), (b), (c) and (d)
Answer: 3

25. The total transportation cost in an initial basic feasible solution to the following transportation problem using Vogel's Approximation method is

	W1	W2	W3	W4	W5	Supply
F1	4	2	3	2	6	8
F2	5	4	5	2	1	12
F3	6	5	4	7	3	14
Demand	4	4	6	8	8	

(A) 76
(B) 80
(C) 90
(D) 96
Answer: B

62. Consider the following statements:
(a) If primal (dual) problem has a finite optimal solution, then its dual (primal) problem has a finite optimal solution.
(b) If primal (dual) problem has an unbounded optimum solution, then its dual (primal) has no feasible solution at all.
(c) Both primal and dual problems may be infeasible.
Which of the following is correct?
(A) (a) and (b) only (B) (a) and (c) only
(C) (b) and (c) only (D) (a), (b) and (c)
Answer: D

63. Consider the following statements :
(a) can be used to minimize the cost.
(b) Assignment problem is a special case of transportation problem.
(c) Assignment problem requires that only one activity be assigned to each resource.
Which of the following options is correct?
(A) (a) and (b) only (B) (a) and (c) only
(C) (b) and (c) only (D) (a), (b) and (c)
Answer: D
Answer: A

21. How many solutions do the following equation have
$x_1+x_2+x_3=11$
where $x_1\geq 1$, $x_2\geq 2$, $x_3\geq 3$
(A) C(7, 11)
(B) C(11, 3)
(C) C(14, 11)
(D) C(7, 5)
Answer: D

<u>Explanation:</u>
x1+x2+x3=11, $x_1\geq 1$, $x_2\geq 2$, $x_3\geq 3$
x1=y1+1, x2=y2+2, x3=y3+3
y1+y2+y3=x1+x2+x3 - 6 = 11-6 = 5
Then the solutions are ${}^{5+3-1}C_5 = {}^{7}C_5$

Theorem: there are C(n+r-1,r) solutions, r-combinations from a set with n elements when repetition of elements is allowed.

28. The initial basic feasible solution to the following transportation problem using Vogel's approximation method is

	D_1	D_2	D_3	D_4	Supply
S_1	1	2	1	4	30
S_2	3	3	2	1	50
S_3	4	2	5	9	20
Demand	20	40	30	10	

(A) x_{11}=20, x_{13}=10, x_{21}=20,
x_{23}=20, x_{24}=10, x_{32}=10,
Total cost=180

(B) x_{11}=20, x_{12}=20, x_{13}=10,
x_{22}=20, x_{23}=20, x_{24}=10,
Total cost=180

(C) x_{11}=20, x_{13}=10, x_{22}=20,
x_{23}=20, x_{24}=10, x_{32}=10,
Total cost=180

(D) None of the above

Answer: D

Explanation:

Correct answer is
x_{11}=20, x_{12}=10, x_{22}=10,
x_{23}=30, x_{24}=10, x_{32}=20,
Total cost=180

59. The perspective projection matrix, on the view plane z = d where the center of projection is the origin (0, 0, 0) shall be

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

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

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

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

Answer: B

24. A basic feasible solution to a m-origin, n-destination transportation problem is said to be .... if the number of positive allocations are less than m + n – 1.

(A) degenerate
(B) non-degenerate
(C) unbounded
(D) unbalanced
Answer: A

70. Given two jugs of capacities 5 litres and 3 litres with no measuring markers on them. Assume that there is endless supply of water. Then the minimum number of states to measure 4 litres water will be

(A) 3
(B) 4
(C) 5
(D) 7
Answer: D

Explanation:

1. (0,0)
2. (5,0)
3. (2,3)
4. (0,3) Now 2 ltr
5. (5,0)
6. (2,3)
7. (0,3) Now 2 ltr (So total 4 Ltr)

5. If we define the functions f, g and h that map R into R by :
$f(x) = x^4$, $g(x)=\sqrt{(x^2+1)}$, $h(x) = x^2+72$, then the value of the composite functions ho(gof) and (hog)of are given as

(A) $x^8 – 71$ and $x^8 – 71$
(B) $x^8 – 73$ and $x^8 – 73$

(C) $x^8 + 71$ and $x^8 + 71$
(D) $x^8 + 73$ and $x^8 + 73$
Answer: D

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

$$F_{00}(0) = 1, F_{00}(1) = 1$$

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

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)

Answer: 1

Explanation:
We have given, $F_{00}(0) = 1$, $F_{00}(1) = 1$
$F_{00}(2) = (10*F_{00}(1) + 100)/F_{00}(0) = 110$
$F_{00}(3) = (10*F_{00}(2) + 100)/F_{00}(1) = 1200$
$F_{00}(4) = (10*F_{00}(3) + 100)/F_{00}(2) = 110$

Since the values repeats after the first three values, the set of values of F_{00} will be (1,110,1200).

3. The functions mapping R into R are defined as:
$f(x) = x^3-4x$, $g(x)=1/(x^2+1)$ 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 $[(x^3-4x)^2+1]^4$
(2) $(x^2+1)^4$ and $[(x^3-4x)^2+1]^{-4}$
(3) $(x^2+1)^{-4}$ and $[(x^3-4x)^2+1]^4$
(4) $(x^2+1)^{-4}$ and $[(x^3-4x)^2+1]^{-4}$
Answer: 4

Explanation:
$hog(x) = h(1/(x^2+1))$
$= [(1/(x^2+1))]^4 = (x^2+1)^{-4}$
$hogof(x) = hog(x^3-4x)$
$= hog(x^3-4x)$

$= [(x^3-4x)^2+1]^{-4}$ [since $hog(x) = (x^2+1)^{-4}$]

1. The Boolean function $[\sim(\sim p \wedge q) \wedge \sim(\sim p \wedge \sim q)] \vee (p \wedge r)$ is equal to the Boolean function:
(A) q (B) $p \wedge r$
(C) $p \vee q$ (D) p
Answer: D

2. If $f(x) = x+1$ and $g(x)=x+3$ then *fofofof* is:
(A) g (B) g+1
(C) g^4 (D) None of the above
Answer: B
Explanation:
If $f(x)=x+1$ and $g(x)=x+3$, then $fog(x)=x+4$ and $gof(x)=x+4$

fof(x)=x+2, fofof(x)=x+3 and fofofof(x)=x+4.=x+3+1=g+1

19. Identify the following activation function :

$$\phi(V) = Z + \frac{1}{1 + \exp(-x * V + Y)},$$

Z, X, Y are parameters

(A) Step function

(B) Ramp function

(C) Sigmoid function

(D) Gaussian function

Answer: C

Explanation:

A sigmoid function(or logistic function) is a mathematical function having an "S" shape (sigmoid curve) is defined by the formula

$$y = \frac{1}{1 + e^{-x}}.$$