MATHS

BOOKS - PEARSON IIT JEE FOUNDATION

LINEAR PROGRAMMING

Example

1. Maximize the function f=4x+5y subject to the constraints

$3x + 2y \leq 18, x + y \leq 7$ and $x \geq 0, y \geq 0.$

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2. A manufacturer makes two models A and B of a product. Each model is processed by two machines. To complete one unit of model. A, machines I and II must work 1 hours and 3 hours respectively. To complete one unit of model B, machine I and II must work 2 hours and 1 hour respectively. Machine I may not operate for more than 8 hours per day, and machine II for not more than 9 hours per day. If profits on model A and B per unit are Rs. 300 and Rs. 350, then how many units of each model should be produced , per day, to maximize the profits ?

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3. A transport company has two main depots P and Q, from where buses are sent to three subdepots A,B and C in difference parts of a region. The number of buses available at P and Q are 12 and 18 . The requirements of A,B and C are 9, 13 and 8 buses respectively. The distance between the two main depots and the three sub-depots are given in the following table (in km).

From ↓ \ To →	A	B	C
P	15	40	50
Q	20	30	70

How should the buses be sent from P and Q to A,B and C, so that the total distance covered by the buses is the minimum ?

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4. Minimize 3x+2y subject to the constraints $x + y \geq 5$ and $x + 2y \geq 6, x \geq 0, y \geq 0$

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5. In an examination, mark obatined by Rohan in two subject are x and y. The total marks in the two subjects is less than or equal to 150. The maximum of marks of each subject is 100. Find the sum of the minimum and the maximum values of 3x+4y. (No negative marks in the examination)

A. 400

B. 550

C. 500

D. 300

Answer: B

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6. Find the maximum value of 4x+7y with the conditions $3x + 8y \leq 24, y \leq 2, x \geq 0,$ and $y \geq 0.$

A. 14

B. $\frac{74}{3}$

C. 21

D. 32

Answer: D

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7. Which of the following is a point in the feasiable region determined by the linear inequalities $3x + 2y \geq 6$ and $8x + 7y \leq 56$?

A. (3,1)

B. (-3,1)

C. (1,-3)

D. (-3,1)

Answer:

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8. The solution of the system of inequalities $x \geq 0, y \geq 0, 5x + 2y \geq 10, 6x + 5y \leq 30$ is a polygonal region with the vertices _____

A. (0,0),(2,0),(0,5),(0,6)

B. (0,0),(5,0) ,(6,0), (0,2)

C. (2,0), (5,0), (0,6), (0,5)

D. (0,0), (0,5),(6,0), (2,0)

Answer:

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9. The length and breadth of a rectangle (in cm) are x and y respectively $x \leq 30, y \leq 20, x \geq 0$ and $y \geq 0$. If a rectangle has a maximum perimeter , then its are is _____.

A. $400cm^2$

B. $600cm^2$

C. $900cm^2$

D. None of these

Answer: B

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Very Short Answer Type Questions

1. Does the point (1,3) lie in the region specified by x-y+2 $>$ 0 ?

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2. The region specified by the inequality $4x + 6y \leq 12$ contains the origin . (True/ False)

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3. Does the point (0,0) lie in the region specified by $x + y \geq 6$?

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4. In a rectangular coordinate system, the region specified by the inequlity $y \geq 1$ lies below the X-axis (

True/ False)

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5. The feasible solution that maximizes an objective function is called _____

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6. If the line segment joining any two point A and B, belonging to a subset Y of a plane , is contained in the subset Y, then Y is called _____.

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7. Does the line y-x+3=0 pass through the point (3,0) ?

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8. If $x > 0$ and $y < 0$, then the point (x,y) lies in the _____ quadrant of a rectangular co-ordinate system.

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9. State whether the point (-3,4) lies on the line, 3x+2y+1=0 or not ?

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10. Define the feasible region.

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11. Define the feasible solution.

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12. The distance of a point P from the positive X axis and positive Y axis are 3 units and 5 units , respectively . Find the coordinates of P.

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13. State which of the following points belong to the region specified by the corresponding inequation that is ,$3x + 4y < 4$

A. (0,2),

B. (3,2)

C. (1,-2)

D. (4,5)

Answer: C

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14. State which of the following points belong to the region specified by the corresponding inequation that is ,$5x - 6y + 30 > 0$.

A. (0,2)

B. (-4,8)

C. (2,3)

D. (4,5)

Answer: D

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Short Anwere Type Question

1. If (0,0), (0,4), (2,4) and (3,2) are the vertices of a polygonal region subject to certain constraints , then the maximum value of the objective funciton f=3x+2y is _____

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2. If (3,2), (2,3),(4,2) and (2,4) are the vertices of a polygonal region subject to certain constraint, then the minimum value of the objective function f=9x+5y is _____

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3. A profit of Rs. 300 is made on class I ticket , and Rs. 800 is made on class II ticket. If x and y are the number of tickets of class I and class II sold, then the profit function is _____

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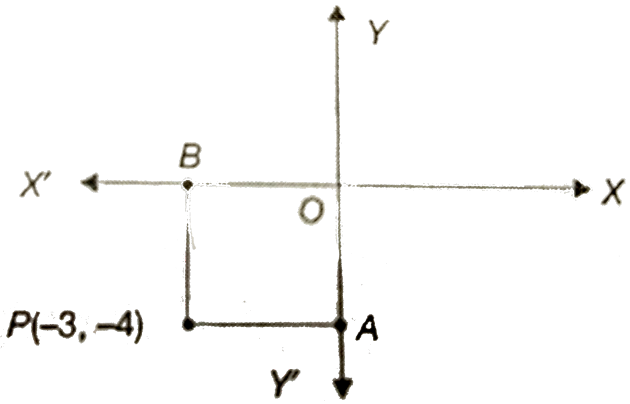
4. In the following figure, find AP and BP.



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5. Draw the graphs of the following inequations .

$x - 4y + 8 \geq 0$

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6. Draw the graphs of the following inequations .

$4x - 5y - 20 \leq 0$

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7. Draw the polygonal region represented by the given systems of inequations.

$x \geq 1, y \geq 1, x \leq 4, y \leq 4$

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8. Minimize 3x+2y subject to the constraints

$x + y \geq 5$ and $x + 2y \geq 6, x \geq 0, y \geq 0$

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9. Define the following Convex set

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10. Define the following Feasible solution

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Easy Type Question

1. A dietician wishes ot mix two type of item in such a way that the mixture contians at least 9 units of vitamin A and at least 15 units of vitamin C. Item (1) unit/kg of vitamin A and 3 units/kg of vitamin C while item (2) contains 3 units/ kg of vitamin C while item (2) contains 3 units/ kg of vitamin A and 5 units/kg of vitamin C. Item(1) cost Rs. 6.00/kg and item (2) costs Rs. 9.00/kg. Formulate the above information as a linear programming problem.

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2. A manufacturer produces pend and pencils. It takes 1 hour of work on machine A and 2 hours on machine B to produce a package of pens while it take 2 hours on machine A and 1 hour on machine B to produce a package of pencils . He earn a profit of Rs. 4.00 per package on pens and Rs. 3.00 per package on pencils. How many packages of each should be produce each day so as to maximize his profit, if he operates his machines for at most 12 hours a day ? Formulate the above information mathematically and then solve.

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3. Santosh wants to invest a maximum of Rs. 150,000 in saving certificates and national saving bonds. Which are in denominations of Rs. 4000 and Rs. 5000. respectively . The rate of interest on saving certificate is 10% per annum, and the rate of interest on national saving bond is 12% per annums. Forulate the above formation as a linear programming problem.

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4. A company manufactures two type of novelty souvenirs made of plywood, Souvenirs of type A

recquire 8 minutes each for cutting and 10 minutes each for assembling. Souvenirs of type B require 10 minutes each for cutting and 15 minutes each for assembling. There are 4 hours available for for assembling. THere are 4 hours available for cutting and 5 hours available for assembling. The profit is 60 paise on each itme of type A and 75 paise on each item of tyep B. Formulate the above information as a linear programming problem.

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5. Find the ratio of the maximum and minimum values of the objective function f=3x+5y subject to

the constraints :

$x \geq 0, y \geq 0, 2x + 3y \geq 6$ and $9x + 10y \leq 90.$

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Level 1

1. If an isoprofit line coincides with the edge of the polygon, then the problem has

A. no solution

B. one solution

C. infinite solution

D. None of these

Answer: C

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2. Which of the following is a convex set ?

A. A triangle

B. A square

C. A circle

D. All of these

Answer: D

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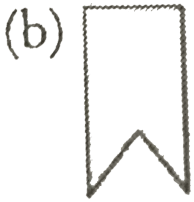
3. Which of the following is not a convex set ?

A. 

B. 

C. 

D. 

Answer: B

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4. Which of the following points belongs to the region indicated by the ineqation $2x + 3y < -6$?

A. (0,2)

B. (-3,8)

C. (3,-2)

D. (-2,-2)

Answer: D

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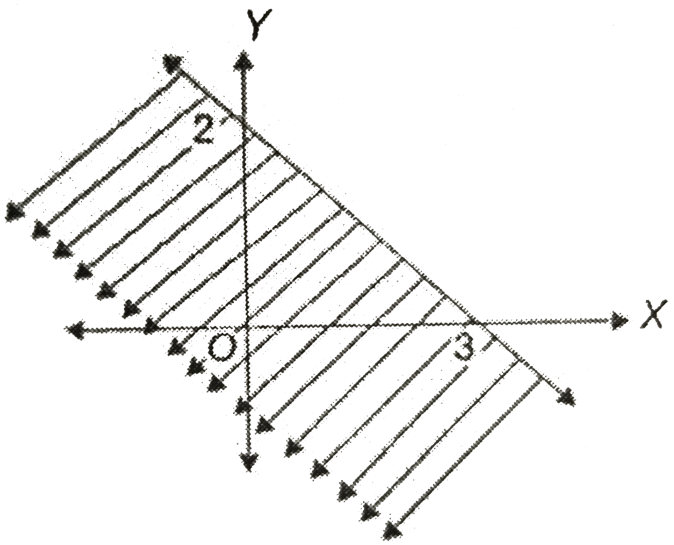
5. The inequation represent by the following graph is



A. $2x + 3y + 6 \leq 0$

B. $2x + 3y - 6 \geq 0$

C. $2x + 3 \leq 6$

D. $2x + 3y + 6 \geq 0$

Answer: C

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6. The minimum value of 2x + 3y subject to the condition

$x + 4y \geq 8, 4x + y \geq 12, x \geq 0$ and $y \geq 0$ is

A. $\frac{28}{3}$

B. 16

C. $\frac{25}{3}$

D. 10

Answer: A

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7. Find the maximum value of x+y subjected to the condition

$4x + 3y \leq 12, 2x + 5y \leq 10, x \leq 0, x \geq 0, y \geq 0.$

A. 3

B. $\frac{20}{7}$

C. 4

D. $\frac{23}{7}$

Answer: D

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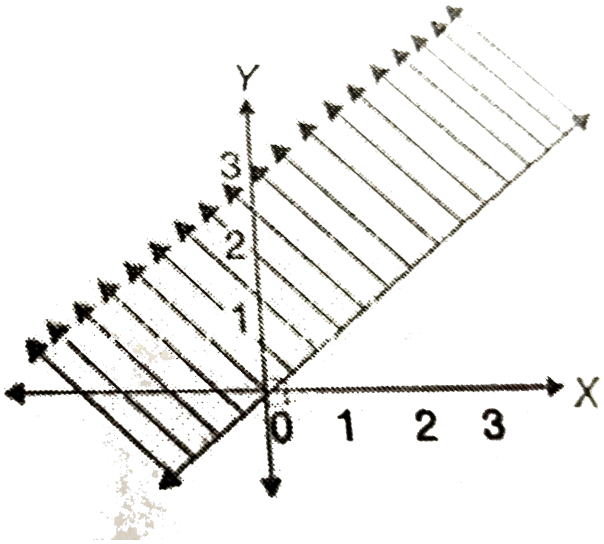
8. The inequation represented by the graph given below is :



A. $x \geq y$

B. $x \leq y$

C. $x + y \geq 0$

D. $x + y \leq 0$

Answer: B

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9. The solution of the system of inequalities $x \geq 0, x - 5 \leq 0$ and $x \geq y$ is a polygonal region with the vertices as

A. (0,0),(5,0),(5,5)

B. (0,0),(0,5),(5,5)

C. (5,5), (0,5), (5,0)

D. (0,0), (0,5), (5,0)

Answer: A

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10. If the isoprofit line moves away from the origin, then the value of the objective functions _____

A. increses

B. Decrease

C. does not change

D. become zero

Answer: A

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11. The solution of the inequations $x \geq 0, y \geq 0, y = 2$ and $x = 2$ form the polygonal region with the vertices (0,0),(0,2),(2,0) and (2,2) and the polygon so formed by joining the vertices is a _____

A. parallelogram

B. rectangle

C. square

D. rhombus

Answer: C

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12. Maximize $5x + 7y$, subject to the constraints $2x + 3y \leq 12, x + y \leq 5, x \geq 0$ and $y \geq 0$.

A. 29

B. 30

C. 28

D. 31

Answer: A

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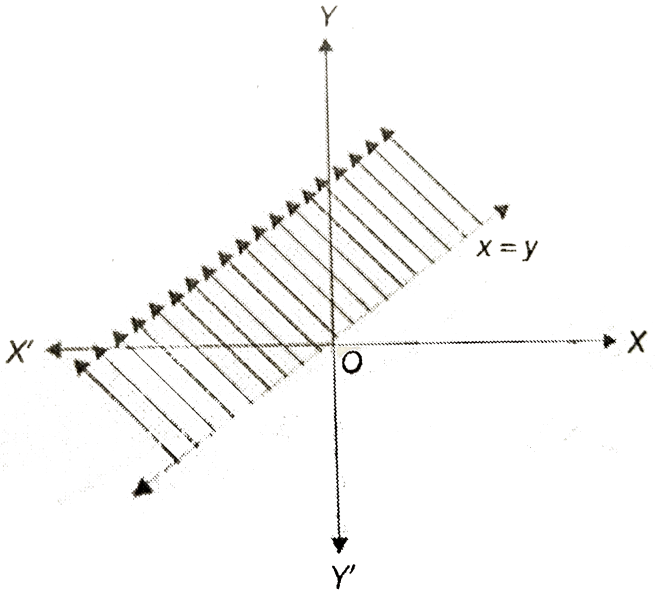
13. The inequation that best describes the graph given below is _____



A. $x > y$

B. $x < y$

C. $x \leq y$

D. $x \geq y$

Answer: B

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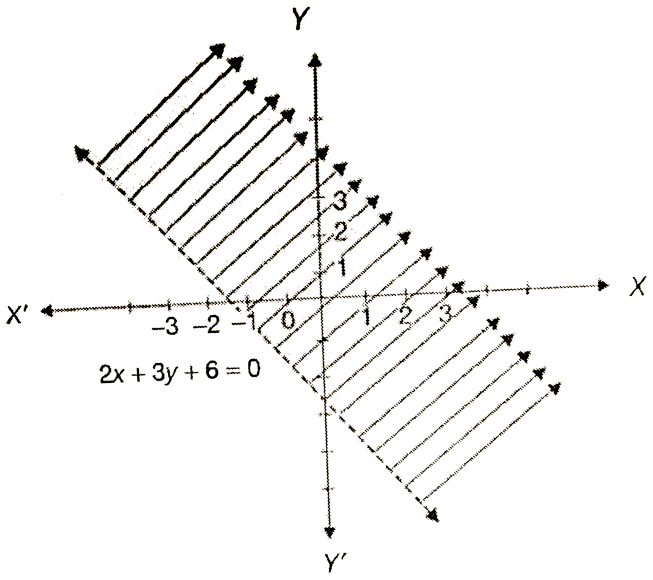
14. The inequation that best describes the following graph is _____



A. $2x + 3y + 6 \leq 0$

B. $2x + 3y + 6 \geq 0$

C. $2x + 3y + 6 > 0$

D. $2x + 3y + 6 < 0$

Answer: C

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15. The vertices of a closed -convex polygon determined by the inequations $7x + 9y \leq 63$ and $5x + 7y \geq 35, x \geq 0, y \geq 0$ are :

A. (7,0),(5,0),(9,0), (0,9)

B. (7,0), (9,0), (0,7), (0,5)

C. (9,0), (6,0), (5,0), (0,8)

D. (0,9),(0,5), (7,0), (3,0)

Answer: B

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Level 2

1. The vertices of a closed convex polygon representing the feasible region of the objective

function are (6,2),(4,6),(5,4) and (3,6). Find the maximum value of the function f=7x+11y

A. 64

B. 79

C. 94

D. 87

Answer: C

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2. If the vertices of a closed - convex polygon are A(8,0), O(0,0), B (20,10), C(24,5) and D(16,20), then find

the maximum value of the objective function $f = \frac{1}{4}x + \frac{1}{5}y.$

A. $7\frac{1}{2}$

B. 8

C. 6

D. 7

Answer: B

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3. Find the profit function p, if it yields the values 11 and 7 at (3,7) and (1,3), respectively .

A. $p = -8x + 5y$

B. $p = 8x - 5y$

C. $p = 8x + 5y$

D. $p = -(8x + 5y)$

Answer: A

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4. A shopkeeper sells x units of books and y units of stationery. If he makes a profit of Rs.2 On each book and Rs. 3 on each unit of stationery, then the profit function is _____

A. $p = 2x - 3y$

B. $p = 2x + 3y$

C. $p = 3x - 2y$

D. $p = 3x + 2y$

Answer: B

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5. The vertices of a closed - convex polygon representing the feasible region of the objective function f are (4,0), (2,4),(3,2) and (1,4) . Find the maximum value of the objective function f=7x+8y.

A. 39

B. 46

C. 49

D. 38

Answer: B

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6. The cost of each table and each chair cannot exceed Rs. 7. If the cost of 3 tables and 4 chairs cannot exceed Rs. 30, form the inequation for the above data.

A. $x > 0, y > 0, x \leq 7, y \geq 7, 3x + 4y \leq 30$

B. $x < 0, y < 0, x \leq 7, y \leq 7, 3x + 4y \leq 30$

C. $0 < x < 7, 0 < y \leq 7, 3x + 4y \leq 30$

D.

$x > 0, \leq y > 0, x \geq 7, y \geq 7$ and $3x + 4y \leq 30$

Answer: C

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7. The vertices of the closed - convex polygon determined by the inequations $3x + 2y \geq 6, 4x + 3y \leq 12, x > 0$ and $y \geq 0$ are

A. (1,0),(2,0),(0,2),(0,1)

B. (2,0),(3,0),(0,4) and (0,3)

C. (1,0),(2,0),(0,2) and (2,2)

D. (1,0),(0,2),(2,2) and (1,1)

Answer: B

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8. Which of the following is a point in the feasiable region determined by the linear inequalities $2x + 3y \leq 6$ and $3x - 2y \leq 16$?

A. (4,-3)

B. (-2,4)

C. (3,-2)

D. (3,-4)

Answer: C

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9. The maximum value of the function f=5x+3y subjected to the constraints $x \geq 3$ and $y \geq 3$ is

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A. 15

B. 9

C. 24

D. Does not exist

Answer: D

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10. A telecom company manufactures mobile phones and landline phone. They require 9 hours to make a mobile phone. The company can work not more than 1000 hours per day. The packing department can

pack at most 600 telephones per day. If x and y are the set of mobile phones and landline phones, respectively , then the inequalities are :

A. $x + y \geq 600, 9x + y \leq 1000, x \geq 0, y \geq 0$

B. $x + y \leq 600, 9x + y \geq 1000, x > 0, y \geq 0$

C. $x + y \leq 600, 9x + y \leq 1000, x \leq 0, y \leq 0$

D. $9x + y \leq 1000, x + y \leq 600, x \geq 0, y \geq 0$

Answer: D

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11. If the isoprofit line moves towards the origin, then the value of the objective function _____

A. increses

B. does not change

C. become zero

D. decrease

Answer: D

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12. The minimum cost of each table is Rs. 10 and each capsule is Rs. 10. If the cost of 8 table and 5 capsules is not less than Rs. 150, frame the inequations for the given data.

A. $x \geq 10, y \geq 10, 8x + 5y \geq 150$

B. $x \geq 10, y \geq 10, 8s + 5y \leq 150$

C. $x \leq 10, y \leq 10, 8x + 5y \geq 150$

D. $x \leq 10, y \leq 10, 8x + 5y \leq 150$

Answer: A

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13. Find the profit function p , in two variable x and y, if it yields the values 23 and 7 at (3,2) and (2,3) respectively .

A. $p = 11x + 5y$

B. $p = 5x + 11y$

C. $p = 11x - 5y$

D. $p = 5x - 11y$

Answer: C

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14. The maximum value of the function, f=3x+5y, subject to the constraints $x \geq 5$ and $y \geq 5$, is _____

A. 40

B. 24

C. 8

D. Does not exist.

Answer: D

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15. The vertices of a closed - convex polygon representing the feasible region of the objective function f =5x+3y , are (0,0),(3,0),(3,1),(1,3) and (0,4) . Find the maximum value of the objective function.

A. 6

B. 18

C. 14

D. 15

Answer: B

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Level 3

1. The cost of each table or each chair cannot exceed Rs. 9. If the cost of 4 table and 5 chairs cannot exceed Rs. 120, then the inequation which best represents the above information are :

A. $x < 9, y < 9, 5x + 4x \geq 120$

B. $x > 9, y > 9, 4x + 5y \geq 120$

C. $0 < x \leq 9, 0 < y < 9, 4x + 5y \leq 120$

D. $0 < \ \leq 9, 0 < y \leq 9, 5x + 4y \geq 120$

Answer: C

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2. The vertices of a closed- convex polygon determined by the inequations $5x + 4y \leq 20, , 3x + 7y \leq 21, x > 0$ and $y \geq 0$ are

A. $(0, 0)(7,)(0, 3)\left(\frac{148}{69}, \frac{45}{23}\right)$

B. $(4, 0)(0, 3)(0, 5)\left(\frac{148}{69}, \frac{45}{23}\right)$

C. $(0, 0)(4, 0)(0, 3)\left(\frac{56}{23}, \frac{45}{23}\right)$

D. $(0, 0)(7, 0)(4, 0)(0, 3)$

Answer: C

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3. The profit function p which yields the values 61 and 57 at (4,7) and (5,6), respectively , is _____

A. $2x + 5y$

B. $7x + 3y$

C. $5x + 2y$

D. $3x + 7y$

Answer: D

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4. The vertices of a closed convex polygon representing the feasible region of the objective function are (6,2),(4,6),(5,4) and (3,6). Find the maximum value of the function f=7x+11y

A. 61

B. 69

C. 59

D. 49

Answer: B

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5. The cost of each table of each chair cannot exceed Rs. 13. If the cost of 5 table and 7 chairs cannot exceed Rs . 250 , then the inequations which best represents the above information are

A. $x > 13, y > 13, 5x + 7y > 250$

B. $x > 0, y > 0, 5x + 7y < 250$

C. $x < 13, y < 13, 5x + 7y \leq 25$

D. $0 < x \leq 13, 0 < y \leq 13, 5x + 7y \leq 250$

Answer: D

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6. The minimum value of f=x+4y subject to the constraints $x + y \geq 8, 2x + y \geq 10, x > 0, y > 0$ is

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A. 4

B. 26

C. 5

D. 8

Answer: D

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7. A tailor stiches trousers and shirts and each piece is completed by two machine I and II. To complete each trousers, machines I and II must work 3/2 hours and 2 hours respectively, and to complete each shirt, machines I and II must work 2 hours and 1 hours respectively Machine I may not operate for more than 12 hours ped day and machine II not more than 11 hours per day. If the profit on each trouser and each shirt is Rs. 150 and Rs. 100 repectively, then the maximum profit is _____

A. Rs. 900

B. Rs. 500

C. Rs. 375

D. Rs. 600

Answer: A

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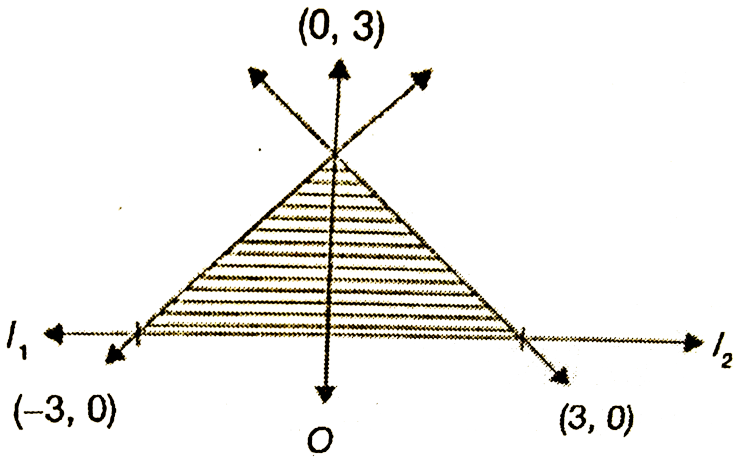
8. Which inequations represent the shaded region in the given figure



A. $y > 0, x + y \leq 3, x - y \geq -3$

B. $x \geq 0, x \pm y \leq 3$

C. $y \geq 0, x \pm y > -3, -3 \leq x$

D. $x \geq 0, x \pm y \leq -3$

Answer: A

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9. A telecom company offers calls for day and night hours. Calls can be aviled 8 hours during the day and 4 hours at night and at most 10 hours a day . The profit on the day calls is Rs. 60 per hour, and on night calls Rs. 50 per hours. How many hours during the day and at night a customer must use to fetch a maximum profit to the company ?

A. 6 hours during day and 4 hours at night

B. 5 hours during day and 5 hours at night

C. 8 hours during day and 2 hours at night

D. 6 hours during day and 2 hours at night .

Answer: C

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10. On a rainy day , a shopkeeper sells two colours (black and red) of umbrellas. He sells not more than 20 umbrellas of each colour. At least twice as many black ones are sold as the red one. If the profit on each of the black umbrellas is Rs. 30 and that of the red ones is Rs. 40 , then how many of each kind must be sold to get a maximum profit ?

A. 20,10

B. 30,15

C. 40,20

D. 10,5

Answer: A