MATHS

BOOKS - A N EXCEL PUBLICATION

LINEAR PROGRAMMING

Question Bank

1. A dealer manufactures ceiling fans and table fans. He has Rs. 9000 to invest and a store to keep atmost 75 pieces. A ceiling fan costs him

Rs. 300 and a table fan Rs. 200. He expects a profit of Rs. 50 on a ceiling fan and Rs. 20 on a table fan. Assuming that he can sell all the fans that he manufactures, express it as a linear programming problem.

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2. A farm is engaged in breeding pigs. The pigs are fed on various products grown on the farm. To ensure certain nutrient constituents X,Y and Z, It is necessary to mix two types of feeds A and B . One unit of product A contains 36 units of X,

3 units of Y and 20 units of Z. One unit of product B contains 6 units of X, 12 units of Y and 10 units of Z. The minimum requirement of X,Y and Z is 108 units, 36 units and 100 units respectively. Product A costs Rs. 20/unit and product B costs Rs 40/unit. Formulate this problem sa a linear programming problem to minimize the total cost.

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3. Solve the linear programming problem graphically:

Max: $z = 3x + 2y$

Subject to:

$x + 2y \leq 10, 3x + y \leq 15, x \geq 0, y \geq 0$

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4. Solve the following linear programming problems graphically

Minimize Z = x + 2y

Subject   to

$2x + y \geq 3, x + 2y \geq 6, x \geq 0, y \geq 0$

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5. Solve the following problem graphically.

Minimise and Maximise $Z = 3x + 9y$

subject to the constraints: $x + 3y \leq 60$, $x + y \geq 10, x \leq y, x \geq 0, y \geq 0$

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6. Solve the following linear programming problems graphically. Maximise z = 3x + 4y

subject to the constraints: $x + y \leq 4, x \geq 0, y \geq 0$.

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7. Solve graphically.

Maximise $Z = 5x + 3y$

Subject to the constraints

$3x + 5y \leq 15, 5x + 2y \leq 10, x \geq 0, y \geq 0$

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8. Solve the following LPP Graphically,

Minimise, $Z = 3x + 5y$

Subject to constraints,

$x + 3y \geq 3, x + y \geq 2, x \geq 0, y \geq 0$

9. Solve the linear programming problem graphically:

Max: $z = 3x + 2y$

Subject to:

$x + 2y \leq 10, 3x + y \leq 15, x \geq 0, y \geq 0$

10. Solve the following linear programming problems graphically

Minimize Z = x + 2y

Subject   to

$2x + y \geq 3, x + 2y \geq 6, x \geq 0, y \geq 0$

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11. Solve the following L.P.P. graphiclly . minimize

and maximize z = 5x + 10y subject to

$x + 2y \leq 120, x + y \geq 60, x - 2y \geq 0, x, y \geq 0$

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12. Minimize and maximize z = x + 2y subject to

$$x + 2y \geq 100, \, 2x - y \leq 0, \, 2x + y \leq 200, \, x, y \geq 0$$

.

13. Maximise $z = -x + 2y$ subject to the constraints:

$$x \geq 3, \, x + y \geq 5, \, x + 2y \geq 6, \, y \geq 0$$

14. Maximise z = x + y, subject to

$x - y \leq -1$, $-x + y \leq 0$, $x, y \geq 0$.

15. A dietician wishes to mix two type of foods in such a way that vitamin contents of the mixture contain at least 8 units of vitamin A and the 10 units of vitamin C. Food I contains $2\dfrac{unit}{kg}$ of vitamin A and $1\dfrac{unit}{kg}$ of vitamin C. Food II contains $1\dfrac{unit}{kg}$ of vitamin A and $2\dfrac{unit}{kg}$ of vitamin C. It costs Rs.$\dfrac{50}{kg}$ to purchase food I and

Rs. $\dfrac{70}{kg}$ to purchase food II. Formulate this problem as a linear programming problem to minimise the cost of such a mixture ?

16. (Manufacturing problem) A manufacturer has three machines I , II and III installed in his factory. Machines I and II are capable of being operated for at most 12 hours where as machine III must be operated for atleast 5 hours a day. She produces only two items M and N each requiring the use of all the three machines. The

number of hours required for producing 1 unit of each of M and N on the three machines are given in the following table:

Items	Number of hours required on machines		
	1	II	III
M	1	2	1
N	2	1	1.25

She makes a profit of Rs 600 and Rs 400 on items M and N respectively. How many of each item should she produce so as to maximise her profit assuming that she can swll all the items that she produced ? What will be the maximum profit ?

17. A firm produces two different products A and B . Each product has to undergo three operations before it takes the final shape. The profit per unit and time required per unit of each product in each operation is tabulated below:

Department	Time taken by each unit of product A and B in hours		Maximum time available
	A	B	
Cutting	1	4	24 hours
Mixing	3	1	21 hours
Packing	1	1	9 hours
Net profit per unit of product	Rs. 5/-	Rs. 8/-	

To formulate a linear programming problem write Cutting constraints.

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18. A firm produces two different products A and B . Each product has to undergo three operations before it takes the final shape. The profit per unit and time required per unit of each product in each operation is tabulated below:

Department	Time taken by each unit of product A and B in hours		Maximum time available
	A	B	
Cutting	1	4	24 hours
Mixing	3	1	21 hours
Packing	1	1	9 hours
Net profit per unit of product	Rs. 5/-	Rs. 8/-	

To formulate a linear programming problem write Cutting constraints.

19. A firm produces two different products A and B . Each product has to undergo three operations before it takes the final shape. The profit per unit and time required per unit of each product in each operation is tabulated below:

Department	Time taken by each unit of product A and B in hours		Maximum time available
	A	B	
Cutting	1	4	24 hours
Mixing	3	1	21 hours
Packing	1	1	9 hours
Net profit per unit of product	Rs. 5/-	Rs. 8/-	

To formulate a linear programming problem write Mixing constraints.

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20. A firm produces two different products A and B . Each product has to undergo three operations before it takes the final shape. The profit per unit and time required per unit of each product in each operation is tabulated below:

Department	Time taken by each unit of product A and B in hours		Maximum time available
	A	B	
Cutting	1	4	24 hours
Mixing	3	1	21 hours
Packing	1	1	9 hours
Net profit per unit of product	Rs. 5/-	Rs. 8/-	

To formulate a linear programming problem write Packing constraints.

21. A firm produces two different products A and B . Each product has to undergo three operations before it takes the final shape. The profit per unit and time required per unit of each product in each operation is tabulated below:

Department	Time taken by each unit of product A and B in hours		Maximum time available
	A	B	
Cutting	1	4	24 hours
Mixing	3	1	21 hours
Packing	1	1	9 hours
Net profit per unit of product	Rs. 5/-	Rs. 8/-	

To formulate a linear programming problem write Objective function

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22. A firm produces two different products A and B . Each product has to undergo three operations before it takes the final shape. The profit per unit and time required per unit of each product in each operation is tabulated below:

Department	Time taken by each unit of product A and B in hours		Maximum time available
	A	B	
Cutting	1	4	24 hours
Mixing	3	1	21 hours
Packing	1	1	9 hours
Net profit per unit of product	Rs. 5/-	Rs. 8/-	

To formulate a linear programming problem write Packing constraints.

23. A manufacturer makes two types of tea cups, say A and B. Three machines are needed for the manufacturing and the time in minutes required for each cup on the machine is given below:

	Machine		
	I	II	III
A	12	18	6
B	6	0	9

Each machine is available for a maximum of 6 hrs per day. If the profit on each cup A is 75 paise and that on each cup B is 50 paise. If x and y denote the number of cups of ttpe A and B produced in a day respectively. What is the profit function ?

24. A manufacturer makes two types of tea cups, say A and B. Three machines are needed for the manufacturing and the time in minutes required for each cup on the machine is given below:

	Machine		
	I	II	III
A	12	18	6
B	6	0	9

Each machine is available for a maximum of 6 hrs per day. If the profit on each cup A is 75 paise and that on each cup B is 50 paise. If x and y denote the number of cups of ttpe A and B

produced in a day respectively. What are the linear in equations satisfied by x and y ?

25. A manufacturer makes two types of tea cups, say A and B. Three machines are needed for the manufacturing and the time in minutes required for each cup on the machine is given below:

	Machine		
	I	II	III
A	12	18	6
B	6	0	9

Each machine is available for a maximum of 6 hrs per day. If the profit on each cup A is 75 paise and that on each cup B is 50 paise. Show that 15 tea cups of type A and 30 tea cups of type B should be manufactured in a day to get the maximum profit.

26. Reshma wishes to mix two types of food P and Q in such a way that the vitamin contents of the mixture contain atleast of 8 units of the vitamine A and 11 units of vitamine B. Food P costs Rs . $\dfrac{60}{kg}$ and Food Q costs Rs. $\dfrac{80}{kg}$. Food P contains $3\dfrac{units}{kg}$ of vitamine A and $5\dfrac{units}{kg}$ of vitamine B. While food Q contains $4\dfrac{unit}{kg}$ of vitamine A and $2\dfrac{unit}{kg}$ of vitamine B. Determine the minimum cost of the mixture.

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27. One kind of cake requires 200g of flour and 25g of fat ,and another kind of cake requires 100g of flour and 50g of fat.Find the maximum number of cakes which can be made from 5kg of flour and 1kg of fat assuming that there is no shortage of the other ingredients,used in making the cake.

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28. A factory makes tennis rackets and bats,A tennis racket takes 1.5 hours of machine and 3

hours of craftsman's time in its making,while a cricket bat takes 3 hours of machine time and 1 hour of craftman's time.In a day,the factory has availibilityof not more than 42 hours of machine time and 24 hours of craftman's time.

What no of rackets and bats must be produced if the factory is to work at full capacity?

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29. A factory makes tennis rackets and bats,A tennis racket takes 1.5 hours of machine and 3 hours of craftsman's time in its making,while a

cricket bat takes 3 hours of machine time and 1 hour of craftman's time.In a day,the factory has availibilityof not more than 42 hours of machine time and 24 hours of craftman's time.

if the profit on a racket and a bat isRs20 and Rs10 find maximum profit

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30. A manufacturur produces nuts and bolts.It takes 1 hour of work on machine A and 3 hours on machine B to produce a package of nuts. It takes 3 hours on machine A and 1 hour on

machine B to produce a package of bolts.He earns a profit of Rs.17.50 per package on nuts and Rs.7 per package on bolts.How many package of each should be produced each day so as to maximise the profit,if he operates his machine for at the most 12 hours a days?

Solve the LPP graphically and find the number of packages of nuts and bolts to be manufactured.

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31. A factory manufactures two types of screws, A and B. Each type of screw requires the two

machines, an automatic and a hand operated.It takes 4 minutes on the automatic and 6 minutes on hand operated machines to manufacture a package of screws A, while it takes 6 minutes on automatic and 3 minutes on the hand operated machines to manufacture a package of screws B. Each machine is available for at the most 4 hours on any day. The manufacturer can sell a package of screw A at a profit of Rs 7 and screws B at a profit of Rs 10 . Assuming that he can sell all the screws he manufactures, how many packages of eách type should the factory

owner produce in a day in order to maximise his profit? Determine the maximum profit.

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32. A cottage industry manufactures pedestal lamps and wooden shades, each requiring the use of a grinding/cutting machine and a sprayer. It takes 2 hours on grinding/cutting machine and 3 hours on the sprayer to manufacture a pedestal lamp. It takes 1 hour on the grinding/cutting machine and 2 hours on the sprayer to manufacture a shade. On any day,

the sprayer is available for at the most 20 hours and the grinding/cutting machine for at the most 12 hours. The profit from the sale of a lamp is Rs.5 and that from a shade is Rs.3. Assuming that the manufacturer can sell all the lamps and shades that he produces, how should he schedule his daily production in order to maximise his profit?

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33. A company manufactures two types of rovelty souvenirs made of plywood. Souvenirs of

type A require 5 minutes each for cutting and 10 minutes each for assembling. Souvenirs of type B require 8 minutes each for cutting and 8 minutes each for assembling. There are 3 hours 20 minutes available for cutting and 4 hours for assembling. The profit is Rs 5 each for type A and Rs 6 each for type B souvenirs. How many souvenirs of each type should the company manufacture in order to maximise the profit?

34. A merchant plans to sell twó types of personal computers - a desktop model and a portable model that, will cost Rs 25000 and Rs. 40000 respectively. He estimates that the total monthly demand of computers will not exceed 250 units. Determine the number of units of each type of computers which the merchant should stock to get maximum profit if he does not want to invest more than Rs 70 lakhs and if his profit on the.desktop model is Rs 4500 and on portable model is Rs 5000 .

35. A diet is to contain atleast 80 units of vitamin A and 100 units of minerals.Two foods F1 and F2 are available.Food F1 costs Rs 4 per unit food and F2 costs Rs 6 per unit.One unit of food F1 contains 3 units of vitamin A and 4 units of minerals.One unit of food F2 contains 6 unit of of vitamin A and 3 units of minerals.Formulate this as a linear programming problem.Find the minimum costs for diet that consists of misture of these two foods and also meets the minimal nutritional requirements.

36. There are two types of fertilisers F_1 and F_2, F_1 consists of 10% nitrogen and 6% phosphoric acid and F_2 consists of 5% nitrogen and 10% phosphoric acid. After testing the soil conditions , a farmer finds that she needs atleast 14kg of nitrogen and 14kg of phosphoric acid for her crop. If F_1 costs Rs. $\dfrac{6}{kg}$ and F_2 costs Rs. $\dfrac{5}{kg}$, determine how much of each type of fertiliser should be used so that nutrient requirements are met at a minimum cost , What is the minimum cost ?

37. The corner points of the feasible region determined by the following system of inequalities:

$2x + y \leq 10, x + 3y \leq 15, x, y \geq 0$ are

$(0, 0), (5, 0), (3, 4),$ and $(0, 5)$. Let $Z = px + qy$, where $p, q > 0$. Condition on p and q so that the maximum of Z occurs at both $(3, 4)$ and $(0, 5)$ is a)$p = q$ b)$p = 2q$ c)$p = 3q$ d)$q = 3p$

A. p = q

B. p = 2q

C. p = 3q

D. q = 3p

Answer: D

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38. A dietician wishes to mix two kinds of food X and Y in such a way that the mixture contains atleast 10 units of vitamin A, 12 units of vitamin B and 8 units of vitamin C. The vitamin contents

of one kg food is given below :

Food	Vitamin A	Vitamin B.	Vitamin C
X	1	2	3
Y	2	2	1

One kg of food X cost Rs. 16 and one kg of food

Y costs Rs. 20. Find the least cost of the mixture

which will produce the required diet ?

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39. An aeroplane can carry a maximum of 200

passengers . A profit of Rs. 1000 is made on each

executive class ticket and a profit of rs.600 is

made on each economy class ticket. The airline reserves atleast 20 seats foe exexutive class. However alteast 4 times as many passengers prefer to travel by economy class than by the executive class. determine how many tickets of each type must be sold in order to maximise the profit for the airline. what is the maximum profit?

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40. A fruit grower can use two types of fertilizers in his garden , brand P and Q . The

amounts (in kg) of nitrogen , phosphoric acid , potash and chlorine in a bag of each brand are given in the table. Tests indicate that the garden needs atleast 240 kg of phosphoric acid , atleast 270 kg of potash and atmost 310 kg of chlorine. If the grower wants to minimise the amount of nitrogen added to the garden, how many bags of each brand should be used ? What is the minimum amount of nitrogen

added in the garden ?

	kg per bag	
	Brand P	Brand Q
Nitrogen	3	3.5
Phosphoric acid	1	2
Potash	3	1.5
Chlorine	1:5	2

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